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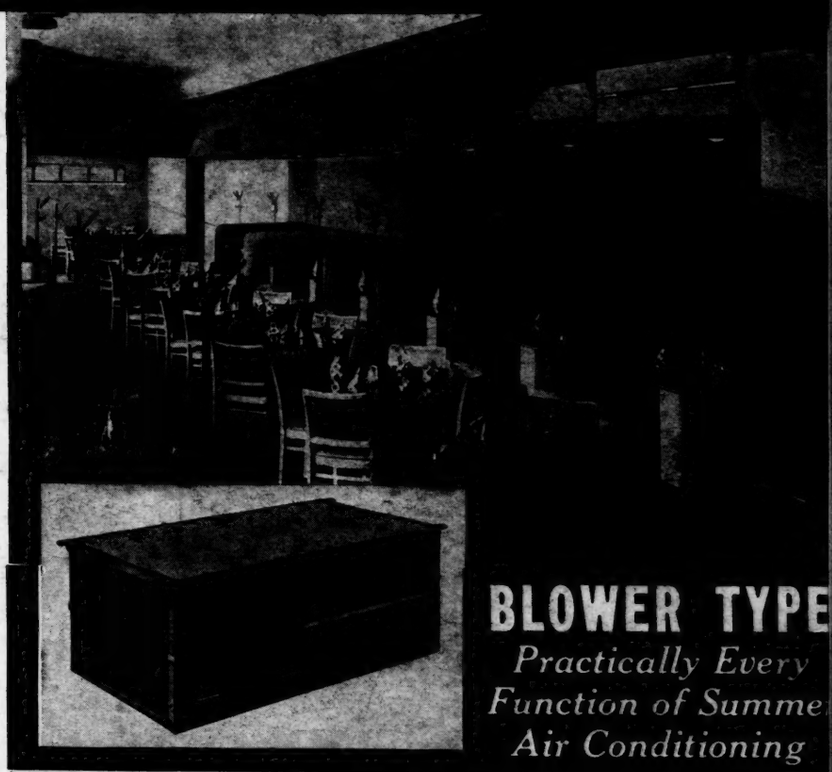

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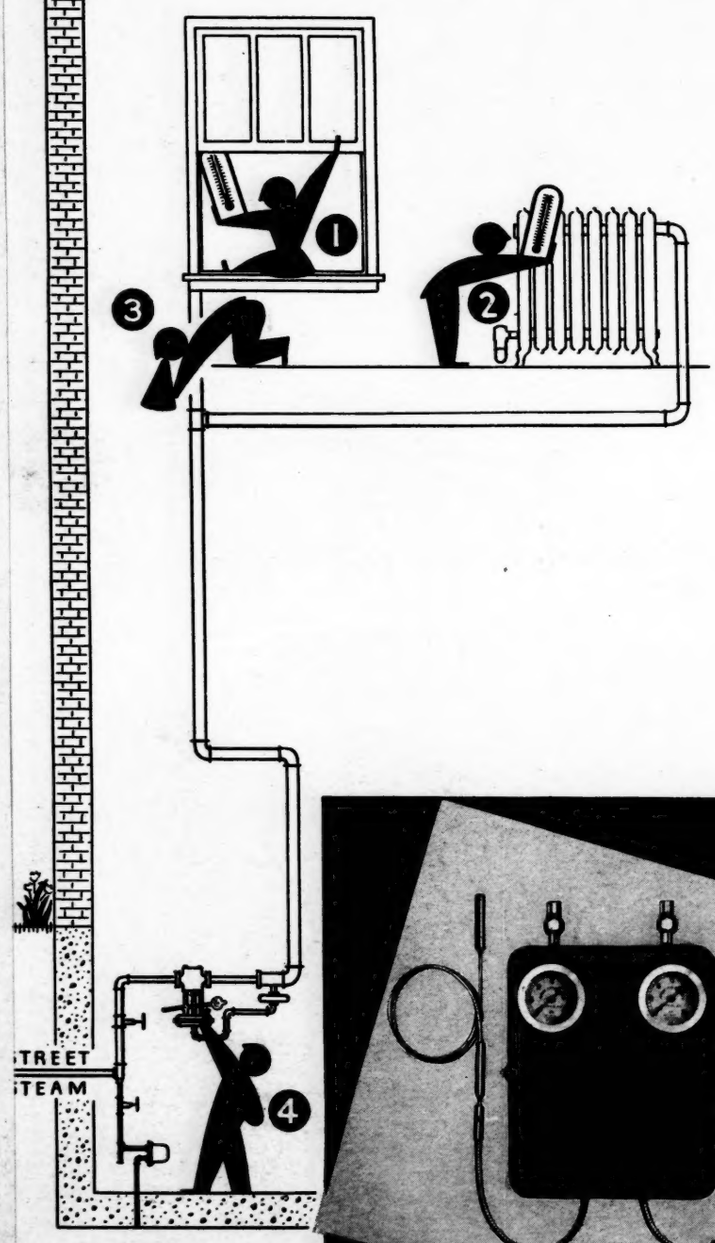

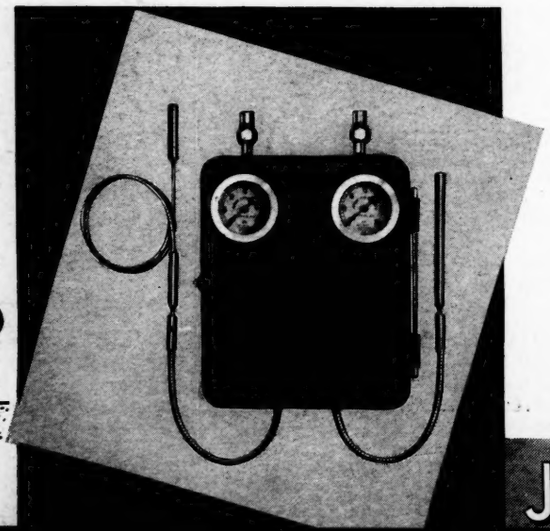

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The Duo-Stat is located at the "last radiator" in the heating zone. Room temperatures are surprisingly Tenant satisfaction is assured. Fuel savings are surp exceeding 25%, in many instances.

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Heating a 5688-Room Housing Project

Exactly 568 structures were demolished to make way for America's largest slum clearance project. Most of these could be classified as slum dwellings since more than 90% were in poor condition, 78% had no central heating plants, 67% were without private toilets, and 78% had no bathing facilities other than old fashioned washtubs. Replacing these are 20 centrally heated, sanitary, fireproof structures housing 1622 families. Heating of these structures is accomplished by a semi-central system consisting of 10 plants, each supplying two buildings. The heating equipment was selected to give efficient and low cost operation. While it does not depart radically from other systems it does incorporate many new features of interest to heating engineers and contractors.

The 25-acre Williamsburg Houses Project, Brooklyn, New York.

THE largest slum clearing housing project in the country, known as the Williamsburg Houses Project, was recently constructed in the Williamsburg section of Brooklyn, N. Y., by the Housing Division of the Public Works Administration. This project when completed was leased to the New York City Housing Authority and is now being operated by that body.

The project covers an area of 25 acres, 30% of which is occupied by 20 four-story fireproof buildings containing 1622 apartments and 44 stores. The 20 buildings have a total of 5688 rooms made up into 49 two-room apartments, 769 three-room apartments, 737 four-room apartments, and 67 five-room apartments.

The project, which has been erected at a land and construction cost of approximately $12,700,000, is bordered by Scholes, Leonard, Maujer, and Bushwick Avenues. All buildings are set at an angle of 15° with the street line so as to receive the greatest amount of the sun's light and at the same time cast a minimum of shadows on adjacent buildings. All the apartments have cross ventilation.

Heating

Ten separate heating plants supply all the steam and hot water for the 20 buildings, each plant serving two buildings. The buildings are heated with a two-pipe, upfeed, low pressure, vacuum system. Heating control equipment operating at sub-atmospheric pressures permits steam distribution at a variable rate to equal the heat losses of the buildings.

The installation of 10 individual heating plants instead of a single central heating plant for the 20 buildings was decided upon for the following reasons:

(1) Central heating plant could not be installed without sacrificing a good deal of rentable space.

(2) Because of the many utilities and crowded conditions beneath the street surfaces, steam distributing lines could not be run across streets without considerable expense.

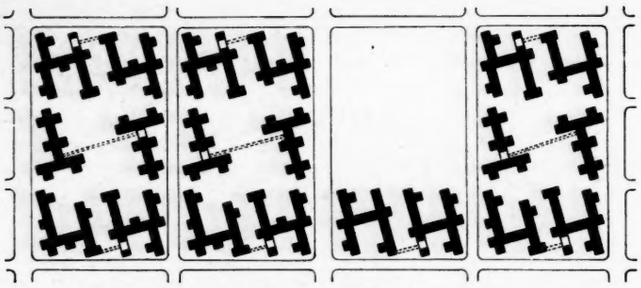
(3) Flexibility of interconnected group heating plants permitted the opening of a few buildings at a time.

Steam Generation

Each boiler plant consists of three low-pressure, firebox, oil-fired boilers, making a total of 30 boilers for the entire project. Three of the plants contain three 60-hp. boilers, the other seven plants contain three 76-hp. boilers. Each heating plant is capable of developing not less than 150% of its actual rating. In actual operation it has been found that two boilers will handle the load satisfactorily, the third boiler being turned on only in exceptionally cold days with high wind velocities.

Pipes interconnecting the adjoining buildings are run in pipe tunnels for easy access for repairs. At each end of tunnel provision was made for expansion by installing swing joints and long offsets with extra heavy fittings.

Boilers are provided with settings designed for burning No. 6 Bunker C fuel oil. Approximately 228 cu. ft.



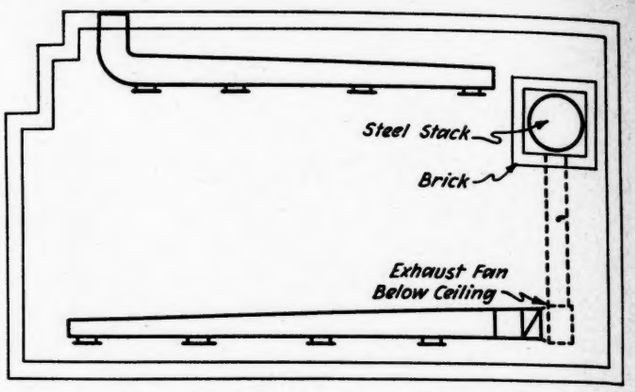


Fig. 1 (Above). Plot plan of Williamsburg Housing Development. White areas indicate the location of heating plants while dotted lines show heating tunnels. Fig. 2 (Right). Plan of false ceiling above boiler room showing supply and exhaust ducts used for ventilation. This together with insulation effectively prevents hot floors in the rooms above the boiler rooms.

combustion space are provided for the 76-hp. boilers and 180 cu. ft. of combustion space for the 60-hp. boilers to assure effective combustion of the fuel oil. The boilers are supported on structural steel independent of the settings.

Boiler rooms are designed so that it is possible to convert from oil to coal should there be a decided increase in the cost of fuel oil in the future. Coal storage space is provided for in each of the 10 heating plants. This space can also be used for drawing and replacing boiler tubes.

In each heating plant there is also the following:

Electric-driven condensation pump and receiver-duplex unit for returning the condensate from hot water generators.

Electric-driven vacuum return pump-duplex unit.

Hot water circulating pump.

Hot water generator storage tank.

Sump pump.

Steam in the various heating plants is generated at from 8 to 12 lb. per sq. in. and is reduced to 2 lb. by a reducing valve before entering the heating system. An automatic control valve varies the amount of steam entering the heating system to meet the heat loss demand. Another reducing valve supplies 5 lb. steam for heating the domestic hot water.

Each reducing valve is provided with a pop safety valve. The boiler safety valves and the pop safety valves are connected to a vent line which runs upward in one corner of the brick enclosures of the steel stacks.

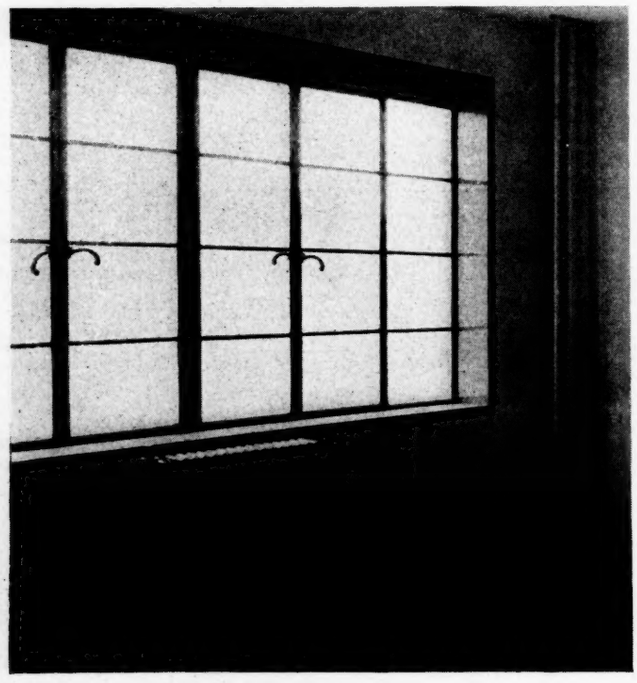
Oil-Burning Equipment

Each boiler is provided with a semi-automatic, rotating oil burner mounted on a front steel plate ¼ in. thick. The burner is equipped with integral motor, blower, atomizing cup, fuel oil pump, relief valve, high and low control and an electric oil valve for cutting off the fuel supply in case of current failure and when removing burner from firing position. In case of flame failure the oil supply is shut off and motor stopped.

Each boiler is also equipped with a low water cutoff, stack switch and pressure switch.

The low water cutoff is so installed that in the event the water is permitted to fall below a predetermined level, it will shut off the burner and not permit it to start until the water line is raised to the proper level.

The stack switch is inserted in the vertical stack connection from the boiler to the breeching and shuts off the burner motor in the event of flame failure.



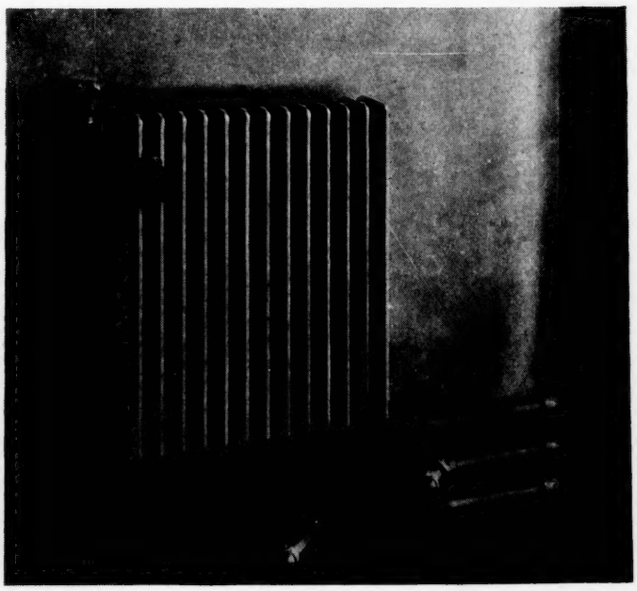


Fig. 3 (Left). A typical radiator installation showing exposed piping connections. Most supply risers are run exposed. Fig. 4 (Above). Top floor kitchens are heated with radiators. An extra trap is provided on the steam supply pipe so that steam circulation can be maintained in exposed risers when radiator is shut off.

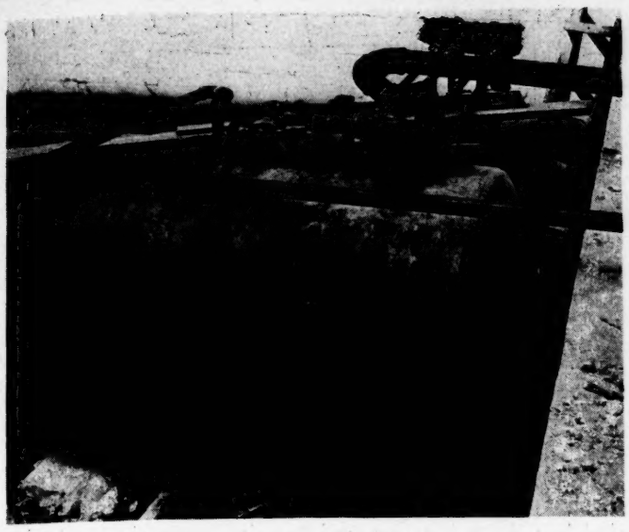


Fig. 5. A typical oil storage tank showing piping connections. Three 2-in. suction lines and one 2-in. return line connect the tank and burner.

The pressure switch shuts the burner off at a predetermined pressure in the event the low fire is too great for the boiler demand.

An alarm system connected to a gong is wired to each boiler to warn of electric current or flame failure. This system receives its current from dry cells.

In addition to these there is provided a barometric draft control for each plant.

A below-the-waterline coil type heater is installed on each boiler for heating of the oil to the temperature required for efficient atomization and combustion. For starting a cold boiler, an electric immersion type heater thermostatically controlled is installed in the suction line to each boiler. Pressure relief valves are installed where necessary.

Fuel oil tanks are buried in the ground near each heating plant and concrete piers were provided to prevent these tanks from settling. The tanks for the large heating plants have a capacity of 8000 gal., while the small plants have 6000 gal. capacity tanks.

Smoke Stacks

Draft for each heating plant containing the three 76-hp. boilers is obtained from a steel stack 42 in. in diameter while those having the three 60-hp. boilers, use a 39 in. diameter stack. Although the stacks vary in diameter they are all 80 ft. high, well insulated and enclosed in brickwork. The stack sizes are ample for burning coal if at a later time it is decided to change over.

Radiators and Risers

Legless narrow tube radiators are hung on radiator brackets below windows in living rooms and bedrooms. Exposed heating risers are utilized for heat in all bathrooms and kitchens, except those kitchens having a high heat loss. Here radiators are installed. Traps on the heating risers are installed at the ceiling of the top floor and the return risers are run in the pipe spaces. Supply risers are generally run exposed with radiator connections above the floor.

Top floor kitchens are supplied with radiators. In order that steam circulation be maintained in the exposed heating riser when this radiator is shut off an extra trap is provided (see Fig. 4).

The radiator valves have a regulating feature so that adjustments can be made to balance the heating system.

Thermostatically controlled unit heaters with propeller fans, two-speed motor controls and adjustable deflectors are installed in all stores and in the nursery school located in building 11. Each unit heater is equipped with a reverse acting surface aquastat strapped to the return connection of the unit heater which opens an electric circuit when the return line cools, thereby stopping the motor. This also prevents the store tenants from using these unit heaters for stirring up the air during the summer.

Insulation

Each boiler is insulated with 1½-in. magnesia blocks

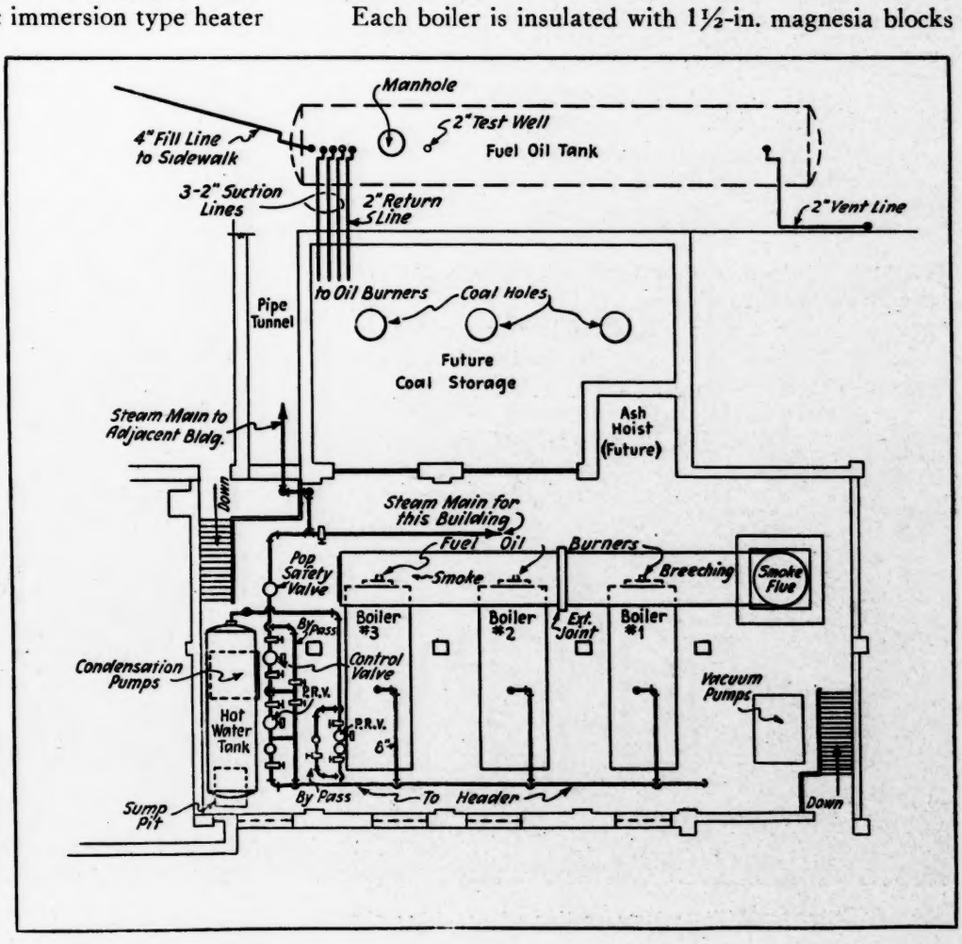


Fig. 6. Schematic diagram of boiler room and underground fuel tank. Piping for the pressure reducing valves is shown between the hot water tank and the No. 3 boiler. Space is provided for coal storage in case it is decided to burn coal at a later date.

held in place by a fibrous adhesive compound with joints beween sections sealed with magnesia cement. After the blocks were properly set, galvanized wire netting was placed over the entire boiler and over this was applied two ½-in. coats of asbestos cement. The second coat contains one part of portland cement to two parts of asbestos cement to give a smooth and hard finish.

The steam mains in the various basements were insulated with 85% magnesia pipe covering of standard thickness with a 6-oz. canvas jacket having pasted canvas flaps and no pipe covering bands. The return mains were not insulated.

Ventilation

A hung ceiling which is well insulated is provided in each heating plant to prevent the heat in the boiler room affecting the apartment above. Ventilation is also provided in the space between the hung ceiling and the floor slab. The above precautions are a positive means of preventing the transmission of heat to the floor above.

Ventilation is accomplished by means of louvered outer wall openings which are connected with sheet metal ductwork for introducing fresh air. A centrifugal fan connected to an exhaust duct removes the air from the hung ceiling and discharges it into the space between the smoke stack and brick enclosure. Pushbutton switch is provided for operating fan (see Fig. 2).

Exhaust fans for ventilation were also installed in laundries, drying rooms and interior toilets.

Domestic Hot Water

In each of the 10 heating plants there is installed an ASME steam heated hot water generator which serves two buildings. The heating elements and tanks vary in size, in proportion to the number of apartments and stores they serve. The sizes and locations of the tanks are listed in the table.

A separate system of piping from the boiler header is run to each generator. On the supply line to each generator there is located a temperature regulating valve, which is actuated by a bulb inserted in the storage tank. Condensate from the heating element of the generators goes to the receiver of the condensation pump and then is pumped to the boilers against boiler pressure. Each generator is provided with a temperature relief and pressure relief valve.

SIZES AND LOCATIONS OF HOT WATER GENERATORS

Building No.	Heating Capacity G.P.H. Each Unit	Storage Capacity In Gallons
1	2000	1200
4	1750	1000
6	2000	1200
7	2200	1350
9	2200	1350
12	1750	1000
14	2200	1350
15	2200	1350
17	1750	1000
20	2200	1350

The domestic hot water system is provided with a small size recirculating line which runs down the farthest plumbing shaft of each wing in the buildings from the hot water line at the fourth floor. This line is carried back to a hot water circulating pump in the boiler room which pumps the water into the generator. This assures instant hot water at the fixtures and eliminates waste and the procedure of permitting the water to run until it gets hot.

The hot water lines are insulated with 85% magnesia pipe covering of standard thickness, with a 6-oz. canvas jacket with flaps pasted.

Equipment

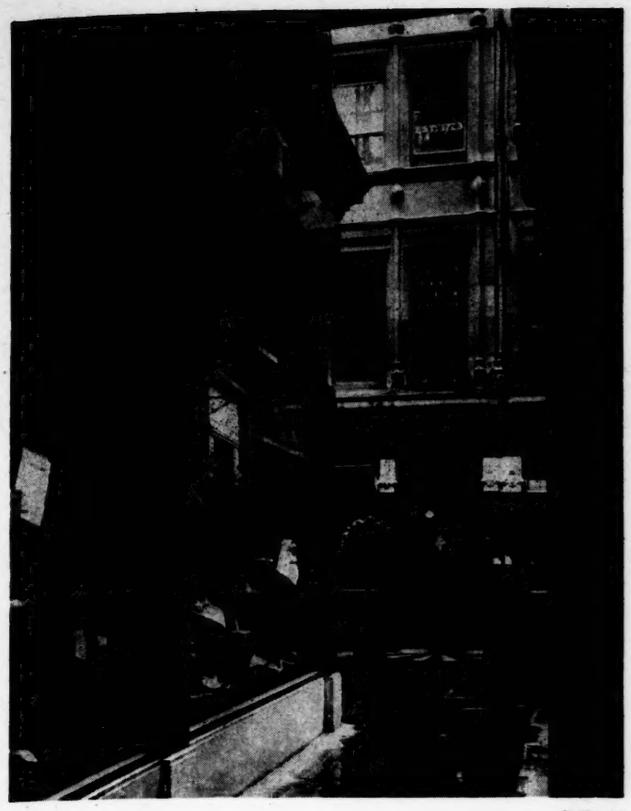
The following approximate quantities will give the reader a rough idea of materials that were installed in the buildings: zone control stations, 12; cast iron radiation, 186,000 sq. ft.; unit heaters and controls, 63; inserts, 12,560; sleeves, 16,000; steam mains and laterals, including boiler room piping, 51,000 lin. ft.; return mains and laterals, including boiler room piping, 51,000 lin. ft.; steam and return risers, 115,400 lin. ft.; steam and return radiator branches, 85,300 lin. ft.; non-conducting covering, 46,000 lin. ft.; fans, motors and controls, 68; radiator valves, 5725; radiator traps, 5725.

The architects for the project were Williamsburg Associated Architects (R. H. Shreve, chief architect) and the consulting engineers were Meyer, Strong & Jones. Baker, Smith & Company installed the heating equipment. R. E. Hall was project engineer, R. Shaw-

(Concluded on page 78)

Fig. 7. Williamsburg section of Brooklyn showing large area occupied by the Williamsburg Houses.

Ventilating Store Windows to Prevent Condensation



Galloway

In this article are described the results of experiments conducted by a British chain store to determine the best methods to overcome the condensation of moisture on store windows. Although climatic conditions in Great Britain are not identical with those in this country, nevertheless the problem exists to some extent in this country and the solution is probably as applicable here as abroad. The article is based on a paper presented by H. A. Stevenson in an address before the British Association for the Advancement of Science.

THE problem of moisture on store windows and its successful solution was dealt with in an address before the recent annual conference of the British Association for the Advancement of Science. The address consisted of an absorbing account of the research work carried out on this problem by Boot's Pure Drug Company which operates England's largest chain of drug stores.

Steamy shop windows have two major disadvantages —they result in the spoilage of merchandise and obscure the display of merchandise, thereby destroying the selling power of the display. In severe cases the display may be hidden for half of the day during six months of the year.

All kinds of devices from glasses of water and lighted candles to variations of tubular heaters have been used in show windows to overcome condensation, but there was no record of any systematic attempt to solve the problem. This is not surprising, for a systematic examination of the problem, such as was undertaken in the experiments described by Mr. Stevenson, demands cooperation between departments rarely found together in one firm. To a concern having over 5000 shop windows and with the necessary facilities for cooperation, such as Boot's, the matter was of such importance as to warrant the erection of an apparatus in which the problem could be investigated.

The experimental shop window erected for the purpose consists of a show window and a window case placed inside a larger case. The window case is similar in size to many of those found in modern shops, being about 3 ft. deep and with a volume of 75 cu. ft. The outer case is divided by a partition in the same place as the window. The space in front of the partition represents the street space and the remainder of the space between the two cases represents the shop space.

For the purpose of the experiment wintertime conditions of temperature and humidity are necessary in the street space. Temperatures well below freezing point are obtained by means of ammonia expansion coils located in the top of the street space and in the refrigeration chamber. By means of thermostatically-controlled electric heaters the temperature can be regulated to any desired point.

As moisture in the street space is deposited on the refrigerating coils, a relative humidity of between 20 and 30% results. By blowing steam into the street space any relative humidity up to 100% can be obtained. The steam inlet is controlled by a solenoid steam valve operated by a hair hygrometer in the street space. A fan at the bottom of the refrigeration chamber draws air from the street space over the refrigerating coils and heaters, mixes it with the humidifying steam and, finally, distributes the air into the street space.

The temperature of the shop space is maintained at 62.5F, this being the average winter temperature in the shops. A relative humidity of 90% is also maintained by blowing in steam. High humidities of this nature are often encountered in shops where they arise from moisture brought in on customers' shoes, moisture exhaled by customers and staff, and from moisture produced by gas heaters. The air in this space is agitated by a fan.

In this window space trays of water provide moisture which, in actual practice, evaporates from goods displayed. Other humidifiers, which are used to produce a steamy window when required, consist of electric

light bulbs covered with muslin which is kept moist by dipping into a constant level water bath. During humidification with this device an oscillating fan is used to distribute the air in the window space. No attempt is made to regulate the temperature of the window space; the temperature gradients are allowed to adjust themselves.

The cause of window condensation is that the temperature of the inner surface of the glass is below the dewpoint of the air in the window case. Therefore, methods for preventing steaminess must aim either at raising the temperature of the inner surface of the glass above the dewpoint of the air in the window or at lowering the dewpoint of the air below the temperature of the inner surface of the glass.

A common application of the first method is to place tubular heaters at the bottom of the window. These, usually, do not warm the whole surface of the glass sufficiently and, moreover, they do not remove any moisture from the window case.

In the second method, two lines of approach are possible. Firstly, drying agents may be used to remove moisture. This is a costly method unless the desiccating agent can readily be regenerated, and even then the inconvenience of the manipulation involved would probably cause the process to be neglected. Moisture can also be removed by replacing the moist air with air containing less moisture; that is, with air of a lower dewpoint.

The only two places from which air can be taken to ventilate the window case are the street and the shop. Assuming that the air from the street is 100% saturated, then the dewpoint of that air is the same as its temperature. As the temperature of the inner surface of the glass is higher than the street temperature, it is also above the dewpoint of the air in the street. Thus, if the air from the window case is replaced by air from the street the window cannot become steamy even when the air in the street is 100% saturated. Similar considerations show that the dewpoint of the air in the shop is usually well above the temperature of the inner surface of the window and must, therefore, be excluded from the window space.

The problem, then, was to determine the optimum conditions for ventilating the window space with the air from the street.

The experimental procedure was to cool the street space, adjust the shop temperature, turn on fans and steam jets, close all ventilators, and allow the apparatus to reach equilibrium. Then the humidifiers in the window space were switched on until the window became steamy and a definite relative humidity was reached. The oscillating fan and humidifiers were then turned off and the whole allowed to stand for a few minutes. On opening the ventilators to the street the window began to clear; the time taken for complete removal of the dew was noted.

In the first experiments the ventilators consisted of a number of slots immediately above and below the window and giving direct communication between the street space and window space. A similar ventilator in the roof of the window case gave communication with the shop space. The results of these experiments show that the best ventilating effect is obtained with ventilators at the top and bottom of the window and giving communication with the street. The roof ventilator has no ventilating effect, and in fact appears to provide a means of entry for moist air from the shop.

A tubular heater was next tested, and it was found that in conjunction with ventilation the heater increased the rate of clearing. Without the heater the rate of clearing was slow and, moreover, the window steamed again very soon after the heater was turned off. It was also found that the more evenly spaced is the ventilating area the shorter is the time of clearing.

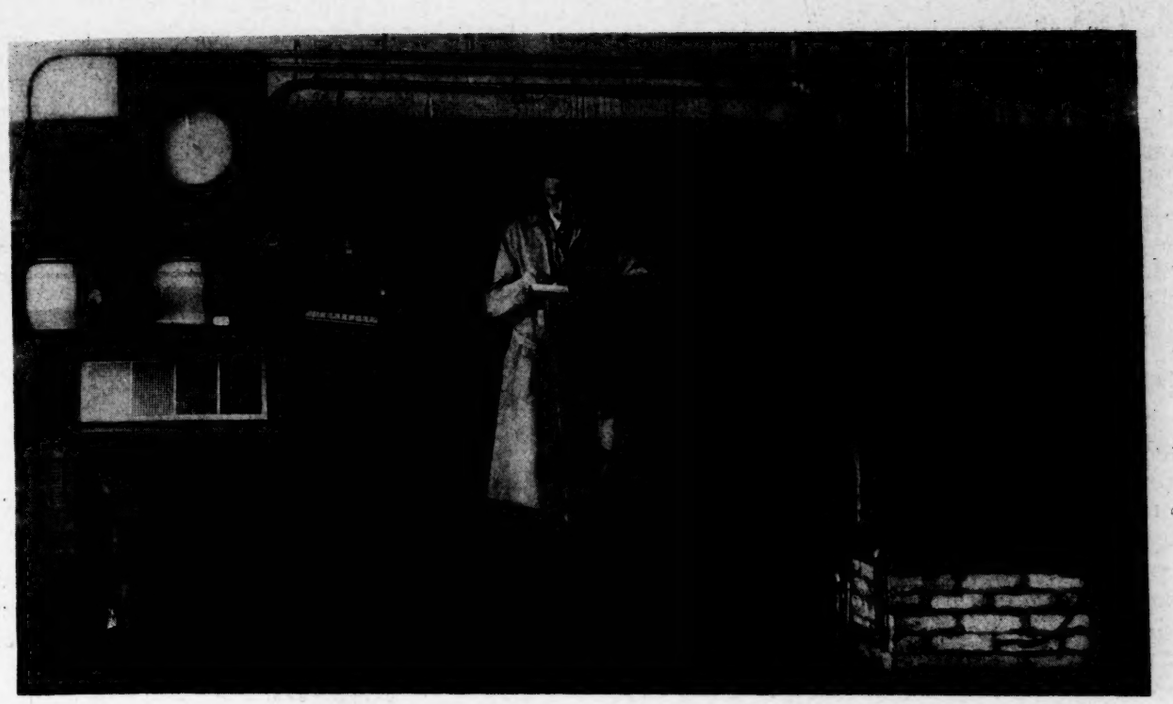
In all these experiments air was admitted to the showcase through ventilators placed just above and just below the window. This is not feasible in actual practice. The usual method is to lead in air through ventilators through the base and then through a grille in the floor of the window case. This arrangement was achieved in the experimental window by placing long boxes over the ventilators, one side of the box being open to the ventilators and another side having a grille leading into the showcase. The grille extended the entire length of the window. The effect of this arrangement was to retard greatly the rate of clearing.

The experiments thus showed that the window could be cleared by adequate ventilation with air from the street; but certain difficulties appeared when the question of ventilating actual shop windows arose. For example, ventilators extending the whole length of the window are, in most cases, objectionable in appearance. Moreover, care must be taken to exclude dust. Experiments with wire gauze dust traps in the experimental window showed that these enormously retarded the rate of ventilation. Difficulty was also experienced by the shopfitters in providing a ventilator at the top of the window owing to the presence of blinds and lighting galleries.

Consequently, methods of forced ventilation were examined, as these appeared to have many desirable features. For example, any desired rate of ventilation can be obtained by choosing a fan of suitable performance; air can be distributed along the entire length of the window from a duct and can be withdrawn through apertures conveniently located in the roof of the window cases. Moreover, the air for ventilation need not be drawn in through the window base, which is an extremely dusty position, but from a less dirty location.

A duct was fitted into the experimental window. The inlet end of the duct is in the street space; the duct then passes through the shop space and delivers air into the bottom ventilator box. As the ventilators are blocked up the air passes into the window space through the grille and is withdrawn through an aperture in the roof. A box contains two filters which are easily removable for cleaning.

This system has been thoroughly tested out in the experimental window under a wide range of conditions. With street humidities up to 100% and street temperatures down to 25F the method has proved to be successful in clearing the window. An air displacement of six changes per hour has been recommended, as this was found sufficient to clear a thickly steamed window in 30 minutes and to be much in excess of the ventilation necessary to keep the window clear under the worst atmospheric conditions.



Overfeed stoker, hot water boiler, and equipment used in overfeed stoker tests.

Overfeed Stokers Tested by Bureau of Mines

OVERFEED domestic stokers were found to operate with efficiencies as high as 70-72% even when working under conditions similar to those encountered in the fields. Even more outstanding than this was the fact that the stoker tested showed approximately the same efficiency when operated either intermittently or continuously. These were the conclusions of investigators of the Bureau of Mines as reported in a recent Report of Investigations 3379, entitled "Burning of Various Coals Continuously and Intermittently on a Domestic Overfeed Stoker," by H. F. Yancey, K. A. Johnson, A. A. Lewis, and J. B. Cordiner, Jr.

The Northwest Experiment Station of the Bureau of Mines decided to make this study of domestic overfeed stokers because of the large number installed in the Seattle area. An estimate of an investigator of the Works Progress Administration indicated that approximately 7000 stokers were being used for residential heating in the Seattle area, most of them of the overfeed type.

It was decided to test a representative overfeed stoker to determine the amount of useful heat that could be recovered with a good furnace and boiler under both intermittent and continuous conditions of operation. Also investigated was the effect of various sizes and ranks of coal as mined in the state of Washington on the performance of stokers.

Stoker Construction

The overfeed type domestic stoker selected for the investigation was one that had proved suitable in about 350 installations for burning washed, non-caking subbituminous coal. This type of stoker consists of a reduction gear box, feed screw, feed tube, fan intake and housing, sliding feed gate, grate, and retort. The sliding gate over the opening in the feed tube and the design of the screw allow the feed rate to be varied between 10 and 25 lb. per hr., depending upon the kind, size, and wetness of the coal. A centrifugal, multivane fan furnishes air to the windbox beneath the retort through the air duct. No damper is used in the duct. The available burning space on the retort is 9 in. wide by 8 in. long.

The boiler used was insulated on two sides and top and is of the size and type commonly used in residential heating. It consists of six vertical cast-iron sections and has a rated capacity of 905 sq. ft. of hot water radiator surface.

When the stoker is operating, the ashes accumulate in the space between the grate and the end of the retort until the force from the continued introduction of fresh fuel pushes them off the end of the retort into the ashpit. In the test unit described the ashes fall into a pan placed beneath the retort and are removed through a door in the back section of the boiler.

Ordinarily, overfeed stokers are installed in furnaces in either of two ways—through the ashdoor with the retort placed below the normal grate level or through the side of the furnace at the grate level. If the ashdoor is used, a pit must be dug beneath the furnace to hold a can into which the ashes fall. The can is removed through a trap door, just outside the furnace wall, which opens to a side extension of the pit. Installation through the side of the furnace at the grate line allows

accumulation and removal of ashes in a normal manner, the same as when firing by hand. In either method it is essential to allow 8 in. or preferably more free space between the end of the retort and the opposite side wall of the furnace, so that strong, sheetlike clinkers, which form with some coals, may be pushed beyond the end of the retort and break off of their own weight before falling into the ashpit. Otherwise the stoker-feeding mechanism may fail because it cannot overcome the excessive load caused by pressure of the clinker against the obstructing wall.

Results of Tests

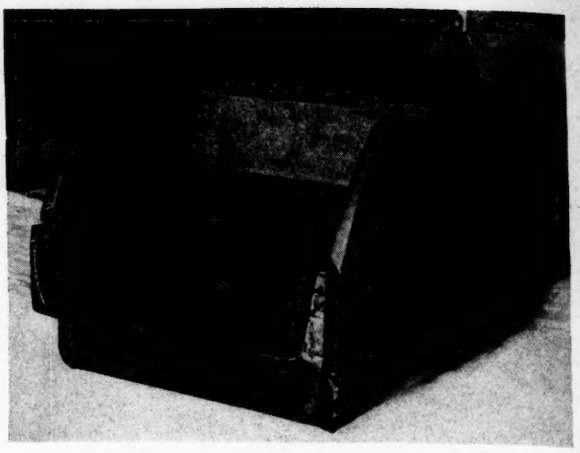
The investigators are careful to point out that the results obtained in this investigation apply exactly only to the particular stoker and boiler installation employed, and to the coals burned in these experiments. The conditions under which the various burning trials were made as far as the installation itself is concerned, were those recommended by the manufacturers of the stoker and boiler. The installation therefore may be considered as typical of residential heating plant construction using similar units. No changes were made in either stoker or boiler which modified its performance or rendered it other than the standard article ordinarily sold to the householders.

The most important observation made during this investigation relates to a comparison of the overall efficiencies obtained in continuous and intermittent trials. Intermittent operation, such as is common practice in domestic heating where the stoker operates as demanded by a thermostat, gave the same or only slightly lower overall efficiencies than did continuous operation. The fire continued to act as an efficient, positive heat source throughout long idle periods when fresh fuel was not being supplied.

Actual efficiencies reported ranged from 72.4 to 70.7% with a firing rate of approximately 20 to 22 lb. per hr. and firing periods from continuous to 10 min. on and 50 min. off. These efficiencies were obtained with a non-caking coal.

Effect of Type of Coal

Coals which may be classified as purely caking showed much lower efficiencies than non-caking coals.



Overfeed stoker retort, showing slotted grate in normal position.

A coal with such caking tendencies may be burned more efficiently at low rates in intermittent operation than in continuous operation because the overall rate of combustion is lower under the intermittent conditions. In general such a coal would prove more unsuitable in household use especially in cold weather.

It was found that a non-caking coal 1 in. to 0 size, could be burned with overall efficiencies ranging from 76% at a rate of 12 lb. per hr. to about 65% at 20 lb. per hr. Two non-caking coals, with the fine sizes smaller than ¼ in. removed, were burned with about the same efficiency at the low firing rate, but with an efficiency of about 5% greater or 70% at the high firing rate. Removal of the fine sizes from the stoker feed decreased considerably the loss of unburned combustible material in the ashes.

In general the overfeed stoker is more suitable for burning non-caking coals than it is for caking coals. This is particularly true when the stoker operates continuously. In actual practice it is possible to burn weakly caking coals satisfactorily because of the lower overall rate of burning with intermittent operation.

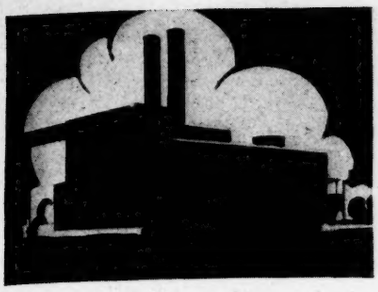
Excess Air Required

The excess air required to burn coal on the overfeed stoker was found to be small; from 25 to 50% appeared to be ample.

Estimating Wind Velocity

MILES	SPECIFICATIONS OF WIND FORCE
less than 1	Calm: smoke rises lazily and vertically.
1-3	Direction of wind shown by smoke drift, but not by wind vanes. Just moves leaves, not branches.
4-7	Wind felt on face; leaves rustle; ordinary vane moved by wind.
8-12	Leaves and small twigs in constant motion; wind extends small flag.
13-18	Raises dust and loose paper; small branches are moved.
19-24	Small trees in leaf begin to sway; crested wavelets on inland waters.
25-31	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.
32-38	Whole trees in motion; inconvenience felt in walking against wind; raises clouds of dust.
39-46	Breaks twigs off trees; generally impedes progress.
47-54	Slight structural damage occurs [chimney pots and slate removed]; hinders walking.
55-63	Seldom experienced inland; trees uprooted; considerable structural damage occurs.
64-75	Very rarely experienced; accompanied by widespread damage.
above 75	Hurricane.

—Hathaway, in the Annual Meteorological Report for 1937, Reading, Pa.



MODERN PRACTICE IN BUILDING GROUP CENTRAL HEATING

A SPECIAL SECTION DEVOTED TO THE CENTRAL HEATING OF COMMERCIAL, INSTITUTIONAL, HOUSING AND INDUSTRIAL PROJECTS

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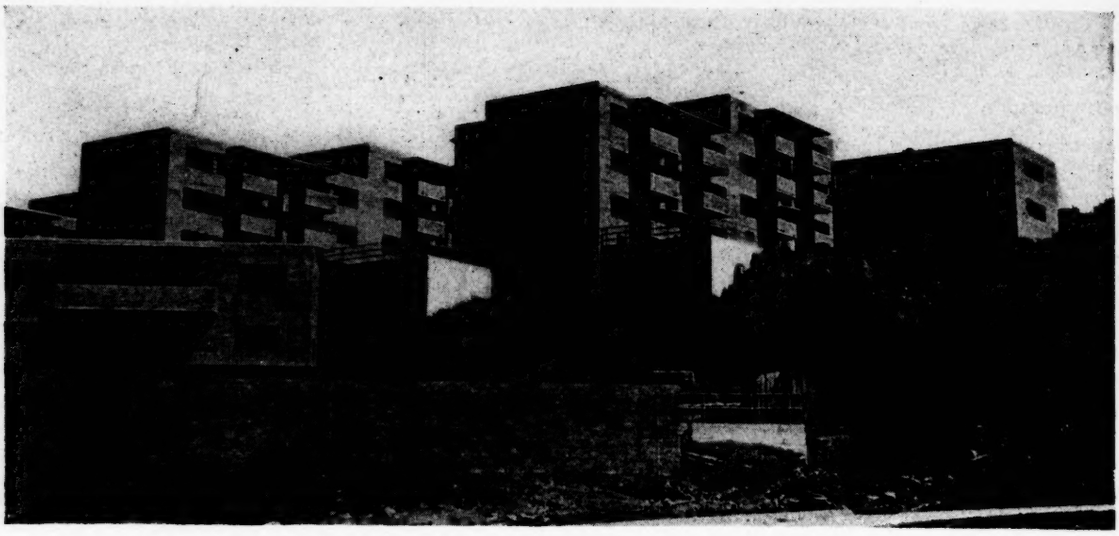


Completed Lake View Terrace housing development.

Heating Cleveland's Lake Front Housing Project

By F. H. VALENTINE†

OF the three Federal Housing projects erected in Cleveland, the Lake View Terrace group on a hillside overlooking Lake Erie, presents many interesting features in design of the heating system which will be described in this article.

The buildings are located on ground which is terraced in many directions providing a clear and practically unobstructed view of the lake for every unit. The project comprises a total of 48 buildings occupying 17.4% of a 22.3-acre site and consists of 620 living units, divided into 170 units for group or terraced houses and 450 units for apartments with a total of 2311 rooms, community building, two store blocks and boiler plant.

The group houses have 26 three-room units, 61 four-room units, and 83 five-room units. The apartments have 246 three-room units and 204 four-room units. The community building contains a health clinic, a day nursery, clubrooms, playrooms, fully equipped kitchen, social hall and an auditorium with seating capacity of 400 people, complete with stage, dressing rooms, and a motion picture projection booth. The two store blocks contain 13 store units together with the project rental and administration office.

Due to the sloping irregular terrain engineering studies of design and mechanical construction for the yard lines were necessary to obtain the quickest delivery of steam from the boiler plant to the various points of building demand and at the same time provide proper service, assurance of operation and economy with suitable arrangement of service mains to insure uninterrupted steam supply to all parts of the project. One interesting feature in connection with the yard distribution system design was a difference in elevation between the boiler room and the highest and uppermost building block on the property, of nearly 80 ft. This condition presented many difficult problems of drainage and grading of mains, as many steam and return mains had to be installed across existing streets in which were water mains ranging in size from 6 in. to 42 in. diameter installed at various depths, also gas mains ranging in size from 4 in. to 12 in. diameter and all of these city utility mains could not be moved or disturbed as they were main feed lines.

All living quarters are heated by means of direct cast iron tube radiators wall hung with branch runouts above floor to risers. Risers in general are exposed in all rooms except the bathrooms. Bathrooms are heated by concealed cast iron convector radiators with flush wall face steel fronts with air inlet and outlet grilles for room recirculation of warm air by gravity. The only radiation in basements is in laundry spaces. All radiators except bathroom convector units are equipped with graduated hand control valves. The bathroom convectors have no steam control valves except the branch supply to riser in basement which has a shutoff valve.

All occupied spaces in the community building except kindergarten and auditorium are heated by means of direct cast iron radiators the same as in living quarters. The kindergarten and auditorium are heated by cast iron convector type radiators fully enclosed in metal casings under windows with bottom inlet openings and top outlet grilles. All radiators except those in the auditorium are equipped with hand control valves. Those in the auditorium are provided with pneumatic diaphragm valves controlled from room thermostats.

†Consulting Engineer, Cleveland.

The ventilating system for the auditorium includes four unit cabinet ventilators, each having a capacity of 1000 c.f.m., taking fresh air from out of doors through grilled wall openings. The exhaust from the room is carried by vent ducts to ventilators on the roof. Each unit ventilator is provided with mixing dampers, recirculating dampers and outside air shutoff dampers.

In this auditorium an interesting dual control arrangement is used. The thermostat controlling the mixing dampers of the unit ventilators is set and adjusted to keep the room temperature within 1F above or below the 70F limit of the thermostat. Should a sudden change occur in the outside temperature (as it frequently does along the lake), causing the room temperature to drop, an insertion thermostat in the unit ventilator discharge outlet, cross connected with the room thermostat, begins to supply additional steam to the unit's heating elements and at the same time adjust the position of the mixing and recirculating dampers to take in part room air mixed with part outdoor air. This latter thermostat is intermediate in its action, opening the steam control valve and recirculating damper gradually and thus avoiding overheating of the air stream leaving the units. As a further control, if the temperature of the air leaving the units should continue to drop to say 60F for any reason such as insufficient steam, the fresh air damper through its action automatically closes off and the recirculating damper opens to full position, thus the room air will be fully recirculated to bring the temperature back to 65F at which point the action of the dampers is gradually reversed. The control is such that steam is never shut off fully from the unit heating element until the bypass mixing damper is fully open, thus preventing cold drafts of air being ejected into the room. This scheme also reduces the steam consumption as a result of a shorter heating period when heating up from a cold room.

Unit heaters operated by propeller fans with two speed motor controls are installed for heating in each of the 13 stores and the 24 laundry drying rooms in the apartment blocks. Each unit is controlled by a thermostatic switch on fan motors as well as a surface contact thermostatic element fastened to the return pipe of the unit and connected in series with the fan circuit to prevent the fan from operating until the unit's radiator is fully heated.

Domestic hot water is provided for all family unit service by 31 hot water generators with a total heating demand of 8320 gal. per hr., heated by steam to a temperature of approximately 140F. These hot water generators are located in various apartment buildings, row house buildings, community building and boiler plant. Each large apartment building has a generator; the smaller row houses are grouped with a generator in one building serving that group by circulating the hot water underground by means of a circulating pump with start and stop control by thermostat installed on the return line before connecting to the generator.

Each hot water generator is heated with steam at 5 lb. pressure reduced by means of secondary reducing valve arrangement in the building service rooms from the yard distribution system, the return condensate from the generator coils being trapped to and connected with the building vacuum return system.

The combined equivalent load in direct radiation not including underground steam mains or building basement mains is equal to 149,587 sq. ft., divided as follows: direct column and convector radiators, 96,200 sq. ft.; unit heaters, 9,847 sq. ft.; hot water generators, 29,120 sq. ft.; exposed uncovered steam risers and radiator supply runouts above basements, 14,420 sq. ft.

For supplying steam to the heating system, a boiler plant is provided at the lowest level of the site. Steam is generated at 80 lb. pressure by three horizontal water tube cross drum boilers set single. Two of these boilers have ample capacity to handle the normal steam demands, leaving the third boiler as a standby or as a booster unit in case of extreme cold weather. Each boiler is fired by an overfeed spreader type stoker capable of burning nut and slack coal and developing a 175% rating of boiler. Air supply for combustion is provided by draft fans located at rear of each boiler, discharging about two-thirds of the air supply below the boiler grates and injecting one-third of the air above the grates through carefully arranged combustion wall openings, thus preheating this air supply.

Automatic draft control is provided to adjust the speed of the stoker feed, forced draft fan speed and forced draft fan discharge damper position from the steam pressure variation. The uptake damper position is controlled to maintain a fixed furnace draft. Each boiler is further equipped with feed water regulator control, soot blowers, three point draft gages, steam flow meters, CO_2 recorder, and other usual boiler accessories.

Coal is supplied to specially designed large capacity coal hoppers erected over the stoker feeders and delivered from the plant's coal storage pocket by means of an electric hoisting and traveling monorail system with bucket of the bottom dump design.

Ashes are removed from the boiler grates to floor hoppers in front of each boiler connected to a vacuum type steam jet conveyor system to an ash storage tank located outside of the boiler house. Fly ash is recovered from the flue gases by means of a cinder trap installed

Interior of the central heating plant for Lake View Terrace.

in the breeching between the boilers and chimney. The ash storage tank has a steam coil to heat damp ashes in winter to prevent freezing.

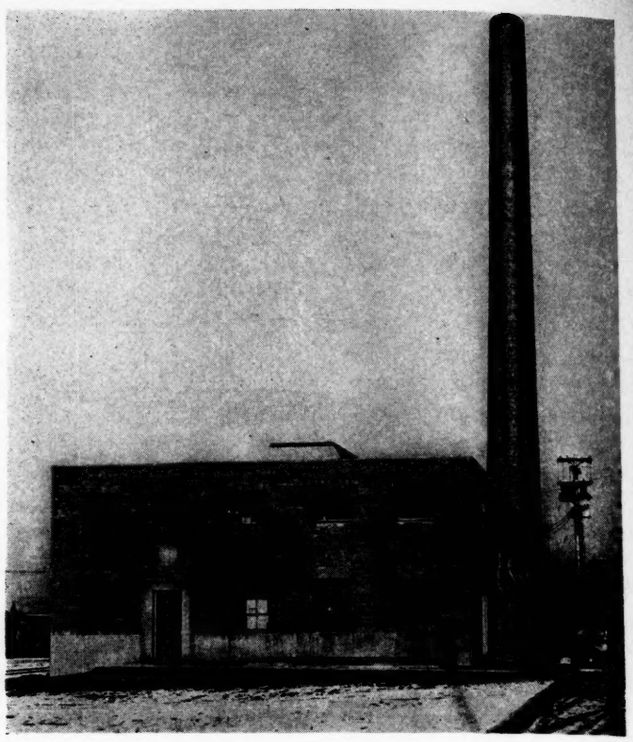
Steam for the heating system is reduced at the boiler plant from 80 lb. header pressure to 30 lb. yard distribution system pressure through a primary reducing valve arrangement of the outside pilot controlled type. The underground mains are extended over the project to the various buildings, being well insulated in Ric-wiL conduit, drained against ground seepage, trapped to remove condensation at strategic points and anchored and guided at suitable places. Expansion loops are used on long runs and expansion joints on short runs.

The underground distributing steam lines were designed on an initial intermediate steam pressure of 30 lb. and with a drop in frictional pressure of 1 lb. per 100 ft. of run, carefully planned with a loop circuit with interconnecting supply mains suitably valved to insure a balanced distribution to all parts of the development as well as an insurance against interrupted service caused by a breakdown on any one section. This underground distribution system consists of approximately 11,200 lin. ft. of tile conduit and base enclosing about 5,990 ft. of steam mains ranging in size from 2½ in. to 10 in. and about 7,130 ft. of return and pump discharge mains ranging in size from 2 in. to 4 in. All underground pipe lines are welded, whereas the piping inside the buildings is made up with screwed joints.

The heating system within the various buildings is of the vacuum return type operating at from 1 to 2 lb. pressure reduced from yard line pressure through secondary reducing valve arrangements located in building service rooms and with thermostatic return traps on all radiators, unit heaters, and drips; combination float and thermostatic traps on all hot water generators. Inverted bucket traps on all intermediate pressure drips entering buildings, discharge to flash chambers which are vented to the atmosphere.

Returns, brought back to a return header in pump stations located in units serving a group of nearby buildings, are here connected to an electric driven duplex vacuum pump. The separate return mains are valved at pump headers to facilitate balancing and testing for leaks and the header provided with a valved bypass pipe connection around the pump to permit of gravity flow of condensate to boiler plant at times of light or moderate condensation load in the buildings. There are four pump stations, one to handle 25,000 sq. ft. of radiation load, two to handle 30,000 each, and one to handle 40,000 sq. ft., the rest of the load at the lower level group of buildings being handled by steam-driven vacuum pumps located in the boiler plant.

During the summer, autumn, and spring season of light load and at other times when justified by weather conditions, the electric vacuum pumps can be bypassed, the condensate from the buildings being returned by gravity to two 10 in. x 12 in. x 12 in. steam-driven vacuum pumps in the boiler plant. During the winter season under maximum condensate, the four electric pump stations are put in operation, discharging the condensate through the underground return mains carried back to boiler plant. Here the pump discharge lines are arranged with a system of bypass lines around the steam-driven vacuum pumps feeding direct to the feed water heater. The steam-driven vacuum pumps discharge their condensate to a vented receiving tank installed at an elevation above the feed water heater from which the condensate drops by gravity to the feed water heater. Both electric and steam driven vacuum pumps are automatically controlled.



Exterior of the heating plant for Lake View Terrace built to harmonize with housing structures.

The feed water heater is of the deaerating type, of capacity to heat 28,000 lb. of water per hour with 15% of total water as makeup at 50F. Water from the storage section of the heater, heated to about 160F, is pumped to the boilers by a 10 in. x 6 in. x 10 in. duplex boiler feed pump of capacity to pump 70 g.p.m. and controlled by excess pressure regulator. The boilers have an auxiliary water feeding system through a single stage, double suction centrifugal electric driven pump of 75 g.p.m. capacity against boiler pressure and the suction of the pump connected up with the feed water heater and city water main. The cold water feed for makeup water is controlled by a float on the feed water storage tank.

A further idea of the size of this project may be obtained from the fact that there was installed in the buildings the following quantities of materials: 3,132 cast iron radiators, with traps and valves; 37 unit heaters in stores and apartment drying rooms; 25,000 lin. ft. of steam mains in building basements; 26,000 lin. ft. of return mains in building basements; 48,000 lin. ft. of steam and return riser piping; 35,000 lin. ft. of radiator supply and return branch pipe; 34,700 lin. ft. of pipe covering in buildings; 78 secondary reducing valve arrangements within buildings.

The buildings of this project were designed by Weinberg, Conrad and Teare, architects, with Mayer and Valentine as consulting mechanical engineers. The Smith and Obey Co., Cleveland, was the heating contractor for the work.

Minimizing Corrosion Problems

CONSTRUCTION and installation of central steam heating supply systems offer the engineer three major problems: (1) he must use, in many cases, 100% makeup water in his boilers; (2) he must furnish pure, dry steam to customers at the farthest point on his lines; (3) he must install a piping system which will give trouble-free service at least long enough for the installation to pay for itself. The first two of these points fall beyond the scope of this article which is confined to a discussion of piping system installation.

Close consideration of the knotty problem of selecting suitable material for a large, complex piping system which must last many years with negligible maintenance and repair expense has led engineers to keep close watch on the performance of many kinds of piping materials already in service. Data collected in this manner over a period of many years show that wrought iron, among the commonly used pipe materials, because of its resistance to corrosion, has proved itself from the standpoint of long economical service life.

However, even though durable piping material be used, it is to the engineer's advantage to take certain precautions which experience has shown will add to the service life of central steam supply plant piping systems.

Corrosion on the interior of steam supply lines is negligible, for the steam in these pipes is dry and attack cannot take place in the absence of moisture. But it has been repeatedly demonstrated that failure can take place, sometimes with astonishing rapidity, by corrosion penetration from the exterior surface of the pipe, even when the line is laid in a tunnel or conduit. Installing the pipe in such a manner that moisture either cannot reach the pipe surface, or is rapidly eliminated as fast as it forms on the metal will reduce such failures to a minimum.

Improper selection, or improper installation of heat insulating wrapping often is the cause of such failure. Every effort should be made to provide a continuous covering of the insulating material which will prevent air from reaching the pipe surface. The reason for this is that where air does get beneath the insulation, condensation can occur on the metal surface when the line is not in operation during the summer months. This condensate becomes acid due to absorption of atmospheric gases and thereby causes rapid corrosion. Furthermore, insulating material containing acid producing compounds should be avoided, as condensed moisture will leech out such compounds from the wrapping and thus render an already bad situation worse.

It is also most important to properly vent tunnels or protective conduit in which steam supply lines are laid so as to permit free air circulation during periods when the line is not in use. Otherwise, moisture from the air will condense on the pipe surface where it will dissolve atmospheric gases and thus become acid as just explained, thereby causing abnormal corrosion. Such vents can be closed when the line is in service.

Condensate lines are, of course, subjected to severe corrosion on the interior of the pipe. The condensate, being in effect distilled water, is devoid of any dissolved solids which would protect the pipe, either by plating out a protective coating of hardness salts on the metal surface, or by neutralizing acids present in the liquid. Accordingly, all horizontal condensate lines should be sloped sufficiently to permit rapid drainage.

Care also should be taken to make certain there are no pockets or low spots where condensate may collect and cause rapid localized attack. Pipe cut on the job should be reamed free from burrs at the cut edge and should be threaded so that there is no pocket at the joint. It is often advisable to make welded joints as such connections are smooth on the inside. Finally, joints should be made perfectly air-tight to prevent infiltration of oxygen from the air. This point is worthy of notice when constructing vacuum return lines.—*C. R. McBride, Eng. Service Dept., A. M. Byers Co.*

Advisory Council to Publicize District Heating

A NEW activity of the National District Heating Association which should be of the utmost importance to the industry is the formation of an Advisory Council, the purpose of which is to advance the knowledge and use of district heating throughout the country and to serve as a means of promoting the mutual interests of all members of NDHA. The membership, as appointed by President T. E. Purcell, is as follows: Chairman, J. H. Walker, The Detroit Edison Company; vice-chairman, D. S. Boyden, Boston Edison Company; T. E. Purcell, The Allegheny County Steam Heating Co., Pittsburgh; J. Earl Seiter, Consolidated Gas, Electric Light and Power Co., Baltimore; Earle Shultz, Illinois Maintenance Co., Chicago; B. M. Conaty, American District Steam Co.; H. W. Coombs, E. B. Badger & Sons Co.; C. Gottwald, Ric-wiL Company; L. H. Plum, Warren Webster & Co.

The Council will endeavor to promote the wider use of district heating in cities where it now exists by educating the public, particularly architects, engineers, contractors, and building owners, to the important advantages of district heating as a method of heating. It will also endeavor to further popularize the service by the educating of the present consumers so that they will use it to best advantage. In cases where new district heating projects are contemplated, the Advisory Council is prepared to make available the accumulated experience of the member companies of NDHA and of the manufacturers.

In furtherance of these objectives the Council is preparing to publish a periodical of the house organ type for distribution by the member companies to their customers, prospective customers, and to local architects, engineers, contractors, and building owners. Extensive study indicates that this will be the most effective form of publicity that could be devised and it should also serve as a means of showing the consumer how to obtain the greatest value from the service.

Indianapolis High-Pressure Service Grows

By JOHN T. DAVIS†

Few businesses, and few utilities, can show a doubling of the volume of their product sold during the depression period. Yet that is substantially what is reported by the Indianapolis utility, so far as its steam service is concerned. This excellent record is due to a considerable extent to the practice of furnishing a high-pressure service to an industrial district. There is also an extensive low-pressure heating service in Indianapolis, but its features and advances are not included here.

Attention has been repeatedly drawn to the possibilities of steam load where a utility furnishes both electric and steam service. Aside from the Indianapolis example another similar project is that at Rochester. Both have gone ahead in spite of the depressed conditions of recent years. They serve as object lessons of what can be done in this direction.

Mr. Davis' statement is a running account of how this activity in Indianapolis has grown during the past seven years.

INDIANAPOLIS has always ranked high in the sale and distribution of public utility steam. While I do not have the figures available to show our relative standing, I feel sure that with the recent installations added to our lines, our station send-out and revenue entitles us to be ranked among the first cities in the United States. Indianapolis is 21st in population.

Until 1931 no serious effort was made to sell steam for purposes other than heating downtown office buildings and a restricted residential area. During 1931, Eli Lilly Company, manufacturer of drugs, was faced with either the renewal of their boilers or buying steam from the public utility. After much study of the problem by the engineers of both the utility and the Eli Lilly Company, a 10-year contract was signed with the Indianapolis Power & Light Company to supply steam for all heating, process work and a certain amount of electrical generation; the remainder of its electric requirements to be taken from our electric system.

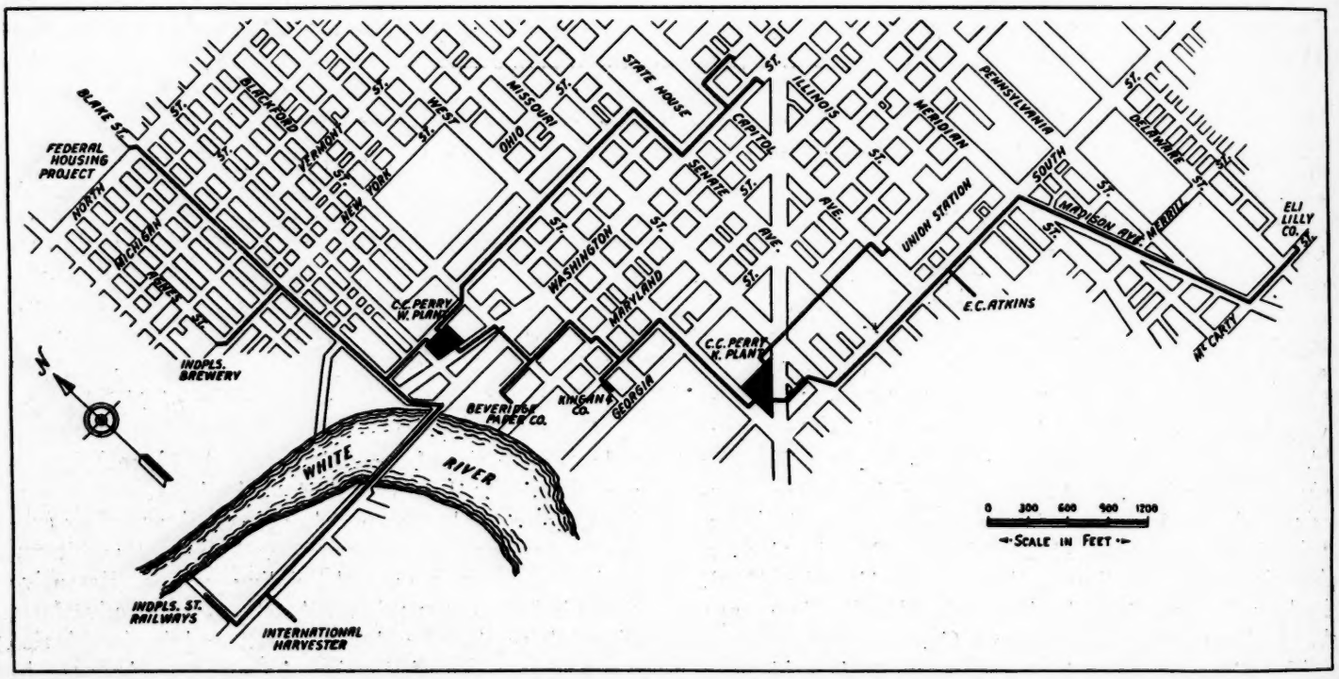
In accordance with the contract, the Power Company constructed a steam line from its C. C. Perry K plant to the Eli Lilly Company, a distance of 5300 ft. Steam is supplied to the customer at 235 lb. and 540F temperature. Since the line was installed, more than 1,500,000,000 lb. of steam have been transmitted without a single interruption of service. So satisfactory has been the relationship between the customer and the utility that an extension of the contract for an additional ten years is being discussed.

In 1933 a service connection was made from the Eli Lilly line to supply the steam requirements of the E. C. Atkins Company, saw manufacturer, which company uses approximately 70,000,000 lb. of steam annually.

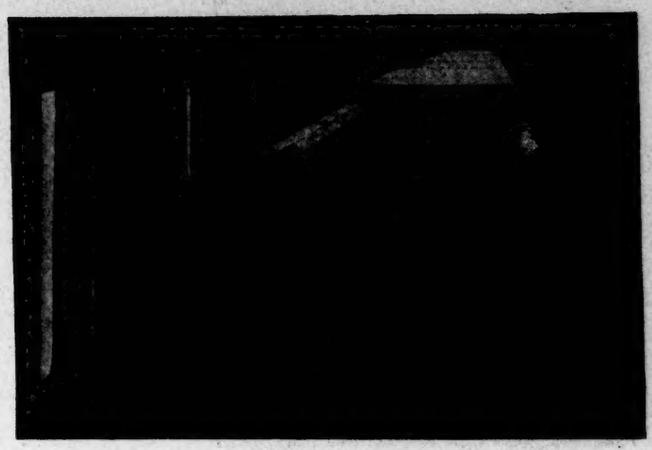
In 1936 a line was constructed between our C. C. Perry K and C. C. Perry W plants carrying steam at 250 lb. pressure and 200F superheat. This line is 3000 ft. long and has a capacity of 650,000 lb. of steam per hr., which permits an interchange of steam between the two plants and provides a means of consolidating them into one operating unit.

The line presents some interesting features of construction, being all welded steel pipe carried on sliding supports welded to the pipe. These supports rest on

†Manager, Heating Department, Indianapolis Power & Light Co.



Map showing location of generating plant and high-pressure distribution mains in Indianapolis. Extensive low-pressure distribution system serving other parts of city not shown.



(Left) Construction detail showing concrete base, insulation, waterproof jacket, slab type conduit and waterproofing. (Right) Insulation completed, ready for completion of conduit, removal of shoring, and refilling of trench.

cast iron plates set in the concrete base. As the supports have practically only point contacts with the pipe, it is possible to cover the entire surface with insulation. Insulation consists of sponge felt 3 in. thick, encased in a waterproof jacket. The entire line is enclosed in a pipe conduit of slab construction consisting of two side walls and top which are interlocked and calked along transverse joints and grouted along the bottom. The top slab is covered with asbestos felt saturated with liquid waterproofing. The precast slabs are composed principally of porous aggregate of volcanic origin. They are reinforced with steel bars and stiffening webs.

The line is trapped at suitable points, the traps discharging into flash tanks which are located in the manholes. The flash tanks are provided with overflow connections to a floor drain to the sewer.

Expansion of the line is provided for with 13 expansion joints with traverse of from 12 to 15 in. each. These joints are provided with fittings for lubrication and are packed under pressure.

Expansion of pipe duct is taken up in the calking between sections and also at the manholes where the duct is free to move into the manhole, being surrounded on all sides with two layers of graphited service sheets.

During the same year, 1936, a 14-in. service connection was made from this line to supply all of the steam requirements of Kingan & Company, large packer and exporter of meats. The steam and electric requirements of this company were of such nature as to permit the installation of a double extraction type turbine. Steam is extracted at 125 and 60 lb. pressure and the turbine operates with 8 lb. back pressure. Steam requirements not supplied by the turbine are taken direct from our incoming line through pressure reducing valves and desuperheaters. All electric requirements not furnished by the turbo generator are taken from our electric distribution system. The steam requirements are the determining factor of electric generation. Kingan & Co. uses approximately 700,000,000 lb. of steam per year.

Also in 1936 a contract was signed with the Federal Government to supply steam for Lockfield Gardens, a housing project under construction in Indianapolis at that time. This project, now completed, consists of 748 apartments, has 110,000 sq. ft. equivalent direct radiation, and uses steam for space heating, water heating and laundry. Electric cooking and refrigeration are used throughout this whole project.

In accordance with the contract a steam line was built from C. C. Perry Plant W to the project, a distance of 3200 ft. It is of all-welded construction with expansion provided by hairpin loops installed in the alleys along the route. The pipe conduit is precast in elliptical sections which make it very easy to install. Steam is transmitted at 175 lb. pressure which is reduced to 50 lb. at the project. Before entering the distribution belt the steam is reduced to 25 lb. pressure and further reduced to 5 lb. before entering the various building groups. Estimated steam consumption is 20,000,000 lb. per year.

In the same year a service connection was made from the Federal Housing line to the Indianapolis Brewery where the steam pressure is reduced to 100 lb. to meet its requirements. The line was also extended south and west across White River to supply the requirements of the street railway shops and a building of International Harvester Company.

Our next large customer was the Beveridge Paper Company whose steam and electric requirements for the manufacture of paper permitted the installation of a turbo-generator. Steam is supplied at 235 lb. pressure and 525F temperature. The turbine, a straight back pressure machine, exhausts at 11 lb. pressure, supplies steam for heating water and drying paper. Steam at 150 lb. pressure is supplied direct from our incoming line, through a reducing valve and desuperheater, to operate the turbines which drive the paper machines. Electric requirements not supplied by the turbo-generator are taken from our electric distribution system, and steam requirements at 11 lb. pressure not supplied by the turbine exhaust are taken from our incoming line through a reducing valve and desuperheater. Steam consumption is estimated at 160,000,000 lb. per year.

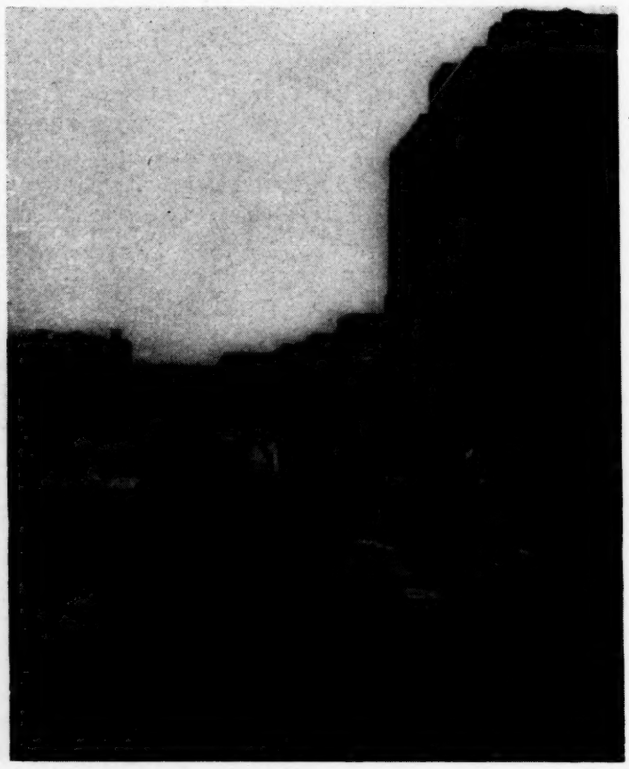
Other recent installations include the U. S. Court House and Post Office, Masonic Temple, K of P Building, Public Library, etc. Our station send-out, not including steam interchanged between Perry K and Perry W plants, has increased from 1,500,000,000 lb. in 1931 to an estimated 3,000,000,000 lb. for 1938.

As we are now negotiating with several large industrial plants to furnish their steam requirements, we feel justified in holding an optimistic attitude for the future.

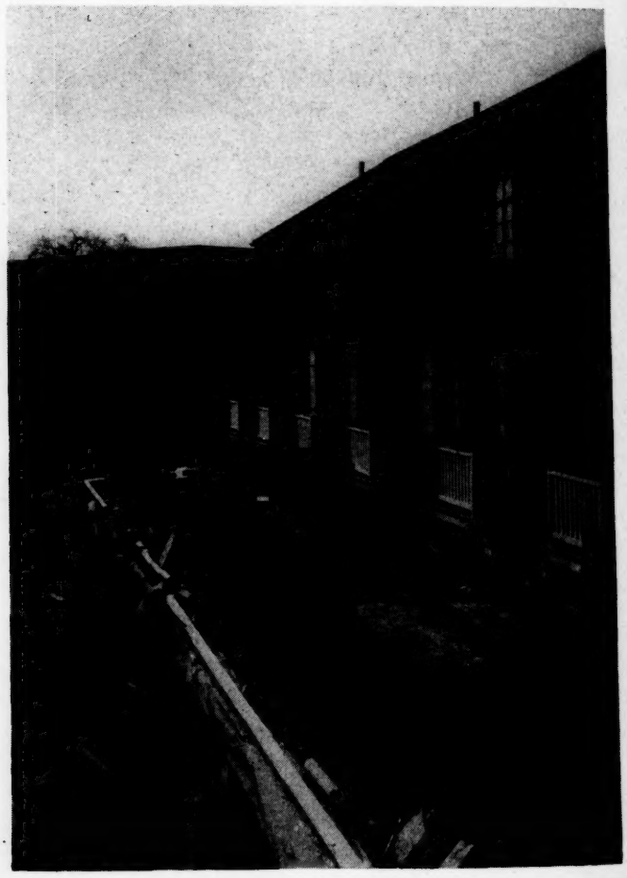
A welded expansion joint (lower right) in a 20-in. main before it branches off to 18- and 14-in. mains. Expansion joints in the branches are not shown but all three joints are of the gun-packed type and are built for operation at 400 lb. with some superheat. Photo by Yarnall-Waring Co.

Steam line to the new Pfaudler plant in Rochester, N. Y., on the lines of the Rochester Gas and Electric Corp. The 12-in. main is shown being encased with cast conduit and dry-packed insulation. Photo by Ric-wiL Co.

Picture Paragraphs



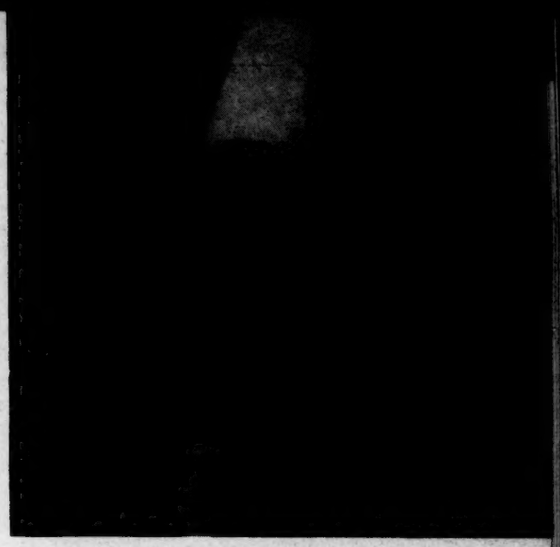
A progress photograph at the Parkside Housing Project, Detroit. The intermediate steam main and return are being insulated and encased in tile conduit. U. S. Housing Authority Photo.



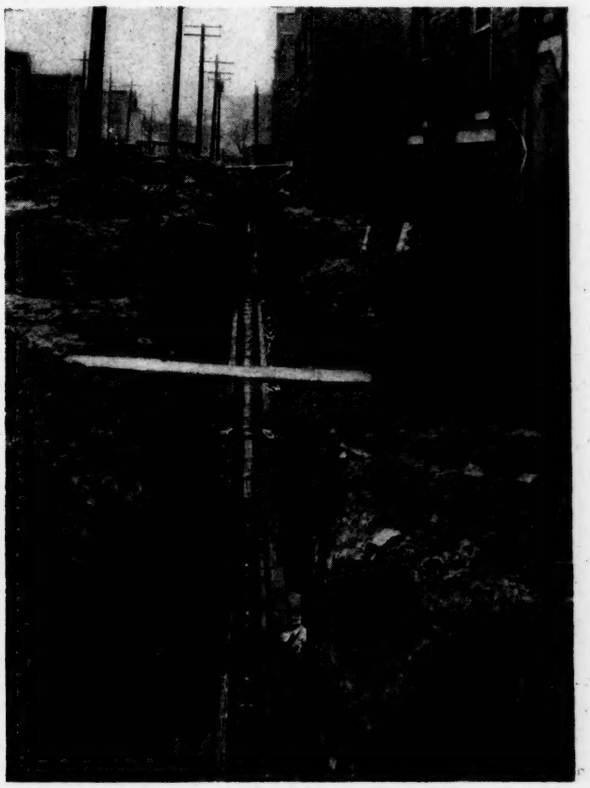
Insulating the steam and return mains on the south side of building 204 of the Parkside Housing Project, Detroit, before application of the unit type conduit. U. S. Housing Authority Photo.

Welding an above-the-ground pipe line. The two expansion joints are both anchored to the concrete block. Note the supports leading from the anchor into the ground to give further rigidity to the block. Photo by American District Steam Co.

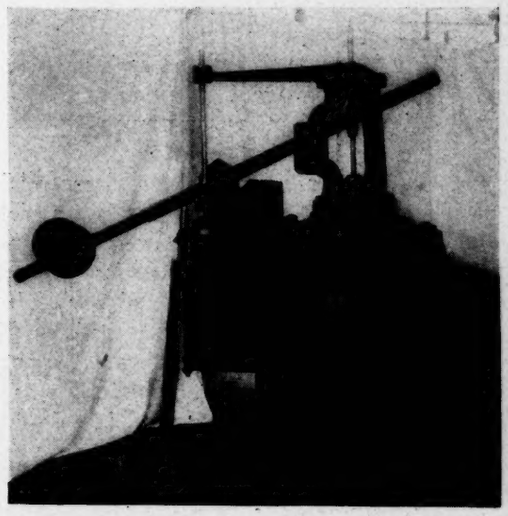
7500 g.p.m. forced draft cooling tower for the heating and generating plant of Owatonna, Minn. Note the architectural treatment. The tower is 65 x 64 x 30 ft. high. Each of the eight cells has an 11-ft. diameter axial flow fan with a total fan capacity of 960,000 c.f.m. Photo by Foster-Wheeler Corp.



A view of the steam distribution system of the Capitol power plant, Washington, D. C., showing an anchor and two Badger expansion joints in the 6-in steam line. A 2½-in. return is carried in the steam conduit which is made of cellular concrete. Photo by S. E. Dockstader.

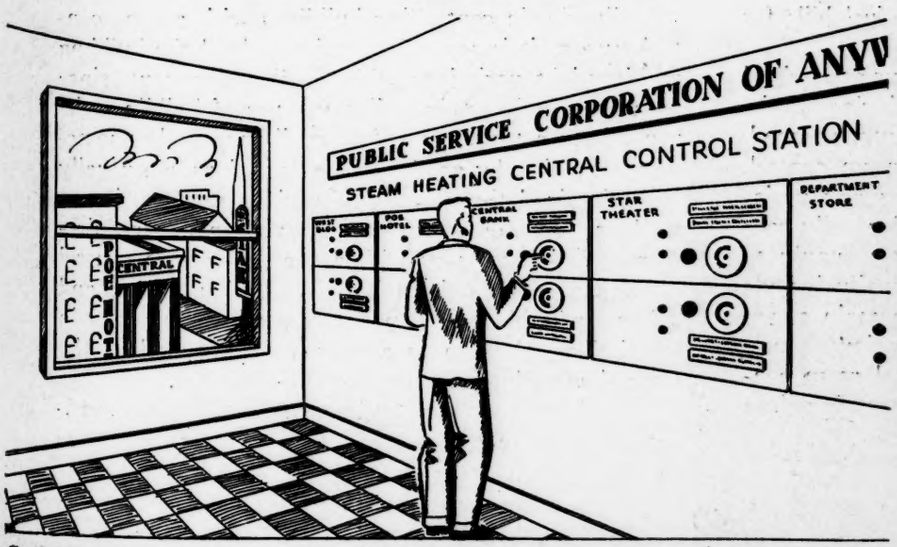


A view of the Brewster Housing Project in Detroit showing the insulation and conduit for the steam line. U. S. Housing Authority Photo.



A specially built 16-in. throttle control valve used with a moderator control in the Bellevue-Stratford Hotel, Philadelphia. Due to the size of the valve a specially designed electric hydraulic mechanism is used for operating it. Photo by Warren Webster & Co.

View under Sixth Avenue and 35th Street, New York, where a subway is being constructed. Overhead is a 20-in. steam bypass crossing 6th Avenue (east and west) and a 12-in. bypass going north. 5660 ft. of New York Steam Corp. mains were relocated to make way for the subway.



Central control of central heating in the future? A control board with a separate remote control for the steam supply to each building located at some central point may some day be achieved on a large scale.

Economy of Automatic Control in Central Station Heating

By R. P. DEWEY†

OPERATION of a large heating plant, whether it be a utility plant or a plant privately owned, serving groups of buildings, involves the operation of costly apparatus, and when considered from the standpoint of the cost of fuel used, expenses of operating personnel, maintenance, amortization, and depreciation of equipment, represents a good-sized business, and one which must be carefully managed in order to show a good return on the investment.

The occupants of buildings heated by such plants usually take it for granted that the heat furnished is just naturally a part of the building service, and since steam is merely piped into the building, there is nothing for them to be concerned about. As a consequence, great extravagance frequently accompanies the heating of buildings, as well as much discomfort on the part of the tenants, due to an uncontrolled heating system.

While many variations of control have been worked out to accommodate different special heating systems, we will endeavor here to cover types of control particularly well adapted to low pressure steam heating and cast iron radiation. We will also attempt to concentrate on office buildings or industrial type buildings, as due to the variation in occupancy of institutional type buildings it is usually necessary to vary the fundamental control to accommodate different sections of the building involved.

In adapting automatic temperature control to any building of the type described, it is necessary to analyze the type of system involved, the requirements of the building, and the requirements of the operating management itself, in order to ascertain what may best suit a given set of conditions. An elaborate control system involving much equipment will give the best control with the least temperature variations, and thereby afford the occupants the greatest comfort. Likewise, a system of this type will also show the greatest economy from the operating standpoint. The cost of such a system, however, must be balanced against the requirements of the occupants, and against the fuel bills for a number of seasons.

Control systems for buildings of the type described can generally be segregated into several classes, the first being what we might term building control; second, zone control; and the third, individual room control. Any of these systems may have one or many variations, but in general, building control will usually consist of a large valve controlling the steam supply to the entire building. Zone control will usually include the installation of several valves off the main steam supply line, which control steam to various zones, wings, or sections of buildings. Individual room control, as the name implies, consists of automatic valves installed on each radiator, controlled by thermostats located in each enclosure. With this type of system, each occupant can have any temperature desired, independently of the temperatures in adjacent rooms or in the balance of the building. Variations are often incorporated into one system; for example, on an individual radiator control system it is possible, and very often arranged for in privately owned plants, to have the system connected so that when all the radiator valves are satisfied, the zone valves, the main building valve, or perhaps the oil burner or stoker will be shut down.

For control of a whole building it is frequently desirable to use some sort of an outdoor thermostatic device for proportioning the amount of heat in the radiators in accordance with outside temperatures. Various systems of this type are available, and may be installed with pilot room thermostats operating on high or low temperature limits. They may be arranged for quick acceleration with timing devices, or may be proportioned directly with a combination of any of these, so as to provide a given amount of heat to the radiators for any range of outdoor temperature. For smaller buildings, many of the cycler or intermittent type control systems have proved very satisfactory, and since they are comparatively simple and inexpensive, are economical from the standpoint of greatest fuel saving versus the investment on control equipment. (Some of the regulators are described on following pages—Editor.) Obviously, it is not possible with a system of this simple type to produce temperatures within very close limits on all exposures and floors widely separated in very large buildings, and as a consequence, when control is adapted to large buildings, it is not only desirable, but usually necessary for producing satisfactory results, to split the building up into smaller sections, and then treat each one of the sections as an individual small building. This type of division is called "zoning," and the control applied is usually called "zone control."

Ordinarily in controlling buildings with a zone control system, it is somewhat easier to hold the building within slight variations with simple equipment, since with open hallways in ordinary types of buildings the zones have a tendency to "temper" one another somewhat, and thereby good average conditions can usually be maintained throughout the various sections, in accordance with outdoor demands and indoor requirements. It is necessary with a zone system to control average conditions throughout the various zones, and it is not possible to automatically vary temperatures in any individual room to any great degree and at the same time maintain a reasonable differential.

One of the economical and satisfactory systems available, both from the standpoint of the purchase price

†Barber-Colman Co., Rockford, Ill.

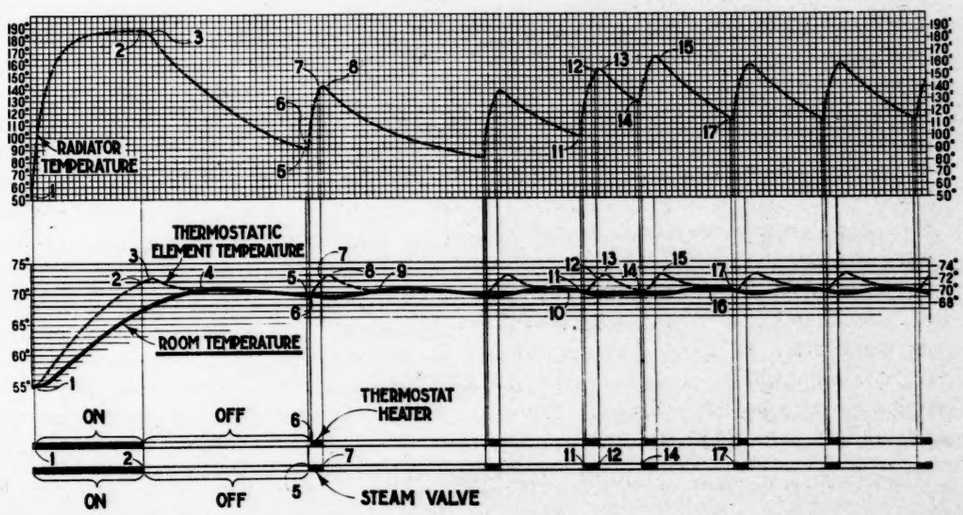
of the apparatus involved, economy from steam saving, and customer comfort, is a system wherein a room thermostat is used in conjunction with a friction type heat actuated switch, both influencing the operation of a steam valve on the supply to a given room or zone. This system functions so that the heat actuated switch on the supply line or radiator energizes an anticipating type heater within the room thermostat, so that anticipation of room temperatures is regulated in accordance with response of temperatures of the heating medium itself. This type of system, while simple, automatically compensates for outdoor temperatures, as well as anticipating for indoor temperature rises, and as a consequence, while it operates as an on-and-off or intermittent system, it functions with frequencies which usually provide for continually warm radiators. The system referred to operates so that when a thermostat in a given area calls for heat, the valve on the steam line is opened. As soon as response is registered at the radiators in the heated area and there is a definite temperature rise at this point, the anticipating heater in the room thermostat is energized, creating momentarily a false temperature within the room thermostat, causing this instrument to close the steam valve before the room temperature has been raised to the desired control point.

This type of control actually makes use of the ordinary "overrun" to do the heating. In other words, since the thermostat is forced off by artificial means, the temperature of its element is heated above the control point of the room about 3F, but just as soon as the heat is turned off, the artificial heat is removed, and the temperature of the thermostatic element soon thereafter becomes the same as that of the room. As a consequence of this artificial condition, there is an actual control point of the thermostat itself; in other words, the operating differential is removed, since the off point always operates under artificial means. With a system of this type it is obvious that since the anticipating effect of the thermostat heater is in direct proportion to the speed of temperature response in the heating medium itself, that compensation for outside temperature changes is automatically provided. This is due to the fact that the thermostatic switch placed in the heating plant or radiator responds always to a *change* in temperature, and is not calibrated at any definite point.

The anticipating effect of this unit can perhaps best be seen by an example. Let us assume that the temperature in the room should be 70F, and it has dropped to slightly under this point. The steam valve is opened, and if the system is rapid in responding, a few degrees necessary change at the thermostatic switch may almost immediately energize the anticipating heater in the thermostat, and within a few minutes create an artificial temperature of approximately 3F in the thermostat, which will cause the valve to close. Usually with very rapidly responding systems and in mild weather the short interval of opening will never much more than allow the radiators to become warm with this type of operation, and after the friction switch device on the radiator has made a contact, it will automatically break this contact when the radiator cools down a slight amount.

Now if, for example, the outside temperature has dropped suddenly, thereby demanding additional heat almost immediately, and if the system has previously operated in a cycle such as just described, and the piping and radiators are already warm when the thermostat calls for heat the second time, it will then be necessary that the steam raise the temperature of the radiator or piping to a higher temperature than that gained by previous valve opening, in order to again energize the anticipating heater in the thermostat. This obviously will take a longer time, and will therefore allow the radiator to gain a higher temperature on this second valve opening. This type of operation might continue if the temperature outside continued to fall, until eventually with the radiation open for a long length of time it would be impossible for the system to become any warmer than it had been on a previous valve opening. At this time the thermostatic switch located on the radiator cannot gain any more heat, and consequently the anticipating heater in the thermostat will not be energized. The system is then at its maximum heating position, and the valve in this case will stay open until eventually the thermostat is satisfied.

With a system of this type it is apparent that since the anticipating heater in the thermostat is energized by a device whose operating characteristics vary from both speed of response and amount of response in the heating plant, that such control provides steam in accordance with heat loss in the building; it should be borne in mind that with this system, the energizing of the thermostat heater is not delayed until a temperature rise has affected the room thermostat, nor is the heater energized as soon as the thermostat calls for heat. It is energized, however, after there has been a definite temperature rise in the heating system, and the faster



Response of heating system, with control apparatus as described showing the progress when starting on day control after night set-back of thermostat.

the response in the heating system, the sooner the anticipating heater in the thermostat is energized. In this system too, since the thermostat controls at a point, rather than between two points, there is practically no differential at the thermostat,—consequently, accurate room temperatures are always maintained.

With individual room control in a building it is possible to have different temperatures in any or all rooms, and with thermostats adjustable by any of the occupants, considerable customer satisfaction is obtained. With this type of system without any safeguard, however, occupants are apt to be careless about open windows, thus defeating the purpose of the control apparatus. Some installations have been made, including individual room control for heating, cooling and air conditioning devices where all the windows and doors of the enclosures have been equipped with window switches and door switches, so that as soon as any window is opened beyond a very small amount, or when any door from any room is opened into a corridor, the heating or cooling apparatus is immediately shut off, and operation is again resumed only when the doors and windows are closed. An installation of this type overcomes the objections to a fine type of individual room control in buildings such as hotels or office buildings.

It is possible with most apparatus now on the market to lock any of the room thermostats for a given high setting, so that temperatures may always be had lower than a given maximum, but so the occupants cannot adjust the thermostat control point above a given limit. It is possible, with any of the control systems described, to include manual operating switches on the system, so that the engineer in charge of the building may, by operating switches in his office, or other centralized point, control the units in the building. For example, a common switchboard installation includes 3-position switches provided for the engineer for operation of any or all controls. These switches allow for automatic operation in one position, for opening the apparatus in another position, and closing it in the third position. Switching of this type may also be accomplished with electric time switches, and may be made fully automatic, if desired.

"Weather-Compensating" Heat Regulators

THERE is, on the market, a group of devices which may be classed as "weather-compensating heat regulators" for the reason that *outdoor* temperature is responsible, in one way or another, for resetting the operating point of these control instruments. The principle here is that the full capacity of the heating system in a given building is required at a certain minimum outdoor temperature, while lesser heating effects, in varying amounts, are necessary at temperatures above that point. Bear in mind that we speak here of "devices," not complete heating systems, for there are a number of different systems which may be installed completely, with certain relationship between traps, pumps, and other elements, in such a way as to be "weather-compensating."

There are three distinctive types of weather-compensating regulating instruments which are most widely known and used, although there are perhaps a score of devices available that have limited distribution or restricted application.

Probably the oldest of the three, insofar as present existence in original form is concerned, operates from the combined effect of the outdoor temperature and the temperature of the heating system, the last named being sensed, usually, at the "last" radiator. For example, if the heating system in a given building has sufficient capacity so that a "hot" (210F) heating system will heat the building to 70F, when it is zero outdoors, it is evident that the heating system at 70F will be sufficient when it is 70F outdoors. In such a case, an instrument is employed which will call for a rise of 2F in the heating system for each drop of 1F in outdoor temperature. Other ratios are available for higher and lower "design temperatures" and for the different maximum temperatures of the heating system which may be required in either gravity or forced hot water heating.

Another of this group of controllers functions from the combined effect of outdoor temperature and "time cycling." A contact-arm, actuated by an element sensing outdoor temperature, moves across a contact plate which is operated, in turn, by a clock mechanism. On the contact plate is plotted a series of "on" and "off" cycles in such a way that heat is turned on for longer periods of time and off for shorter periods, when the outdoor temperature is low. Conversely, when the weather is more moderate, the "on" and "off" periods are made, automatically, shorter and longer, respectively. There are a number of interchangeable contact plates available, so that one may be selected which will provide the correct periods of "heat on" and "heat off" for the particular building in question. For another building, in perhaps the same or another locality, a plate with entirely different plotting of "heat on" areas will be required.

In the third of these regulators, which is mounted outdoors, a block of metal represents the building to be heated and an electrical resistance represents the heating system in that building. By means of a rheostat, the resistance heater is balanced in such a way that it heats the "block" to such a temperature, at a given outdoor temperature, that it will cool off at the same rate as will the building, if heated for the same length of time. Then, if the regulator is hooked up in such a way that steam is turned into the heating system whenever the resistance heater is required to go to work to heat the block in the regulator, the length of time that the block requires, before it cools to a given "comfortable" temperature, will determine the length of the "heat off" cycle, in the building.

All of these devices, in the applications described above, operate to control the heating system by means of intermittent operation, definite cycling between "heat on" and "heat off." Particularly in central station heating, this method has been found to be acceptable, but there are cases where these same instruments may be hooked up in such a way as to accomplish "throttling" control, having practically continuous steam flow.

Modernized Office Building Plant Uses 60% Less Steam

That substantial savings in steam or fuel can be secured when older plants are replaced by the latest equipment is well known. Seldom, however, are unit operating results available over a considerable period of years, during which two major changes in the plant have been made. In this case steam consumption per unit of heating surface was reduced from nearly 525 lb. per season to an average of nearly 200 lb. per season. During the 1936-37 season the unit consumption was over 60% less than during 1927-28. Modern equipment and careful operation pay a high return.

LOCATED at a corner in downtown Baltimore stands the 21-story, twenty-one-year-old Lexington Building constructed of stone and granite terra cotta. It may be called a typical downtown office building since the space is nearly all used for office purposes, but it is notable that this building has enjoyed a high occupancy ratio throughout its life. Moreover, the heating plant has been modernized and altered at various times. From erection up to the 1928-29 heating season, heat was supplied by a private steam generating plant located in the building. During the summer of 1928 it was decided to abandon the operation of this private generating plant and to connect the building to district steam. The necessary changes to accomplish this were made and the building has been operated with district supply since that time. In 1930 the radiator heating system was modernized by altering it from a mechanical vacuum plant to a low pressure gravity installation operating under an adjustable control whereby an operating schedule could be arranged with the hours of heating adjusted to meet changes in the outside temperature. Due to this continuing attempt to keep the building plant modern and also to have it operated by economical methods, the building presents an excellent example of how heat economy can be accomplished.

This building is also rather unusual in layout in that three separate annexes are connected to it. One of these, Annex No. 1, is six stories high, of stone and brick construction, and is directly adjacent to the main building. A bridge leads from Annex No. 1 across an alley to Annexes 2 and 3 which are each five stories high. Unlike the main building the annexes are occupied by various business departments making the heating requirements somewhat different from those of the main building. For example, Annex No. 1 at the present time contains a radio studio which is in use most of the 24-hour period each day. Certain other parts of the annex space, however, are used only a comparatively short time each day, making it possible to cut off the heat supply to them at 5 p.m. on weekdays and at the middle of the day on Saturdays, without the necessity of furnishing heating service on Sundays and holidays. The building and its annexes thus present a complicated operating problem and one which permits both short-hour heating in some sections and long-hour heating in others. Keeping tenants satisfied with their heating service under such a variety of conditions while still obtaining economy means that the plant must be capable of meeting all the wide variations of service necessary.

At present the heating schedule for the plant is set up as shown in Table 1.

Since the control is under the supervision of the operating staff it is possible to adjust it at will to follow the demands of the system while using the tabulated times as a guide.

TABLE 1—HEATING SCHEDULE

Outside Temp., F	Heat On	Heat Off
60	7:45 a.m.	5:30 p.m.
55	7:30	6:30
50	7:15	7:00
45	7:00	7:30
40	6:45	8:00
35	6:00	9:30
25	5:30	10:00
20	5:00	10:30
15	3:30	11:00
0	on all night	

For Annexes:
Heat on one hour earlier than above.
Heat off at 5 p.m. on weekdays.
Heat off at 1 p.m. on Saturdays.
No heat on Sundays or holidays.

Special 24-Hour Service Installed

To take care of the sections of the building and the annexes requiring special service a steam line is installed to serve the Lexington Building telephone exchange room, the radio studio in Annex 1, a mailing room in Annex 2, a printing room in Annex 3, and the top floor of Annex 1. All together the attached radiator surface on these separate lines is 2,264 sq. ft. and their load is

TABLE 2—RECORD OF STEAM USED EACH SEASON FROM 1927 TO 1937

Heating Season	Lb. Steam Used for Season: Per E.D.R.	Per Cu. Ft. of Space	Per E.D.R Per Degree-Day	Type of Plant and Control
1927-28	524.9	6.327	0.1220	Isolated boiler plant
1928-29	322.4	3.886	0.0784	District steam with vacuum heating system
1929-30	317.5	3.828	0.0753	
1930-31	272.3	3.283	0.0625	
1931-32	172.4	2.079	0.0495	
1932-33	182.1	2.195	0.0448	District steam with gravity system and outside thermostat control.
1933-34	220.7	2.661	0.0462	
1934-35	209.4	2.524	0.0479	
1935-36	232.2	2.799	0.0491	
1936-37	191.6	2.310	0.0463	
	63.5	63.4	62.0	% Reduction in unit steam used, '36-37 vs. '27-28.

not under the control of the time scheduling device. This separation of mains was accomplished in January, 1929.

The load which operates under control of the outside temperature device totals 52,745 sq. ft. e.d.r. made up of both direct radiators and unit heaters. There is also a cast-iron, central indirect unit containing the equivalent of 13,552 sq. ft. e.d.r. which is separately controlled and which supplies some heat to basement salesrooms and to the first floor and mezzanine.

The 10-Year Results

Careful records of the amount of steam used and of the costs of operating the heating plant have been kept in this building since the season of 1927-28. As these figures are presented here in Table 2 they give the nine-year record of the cost of heating only after having made allowance for steam used for heating service hot water for the building and steam used for the special 24-hour heating service.

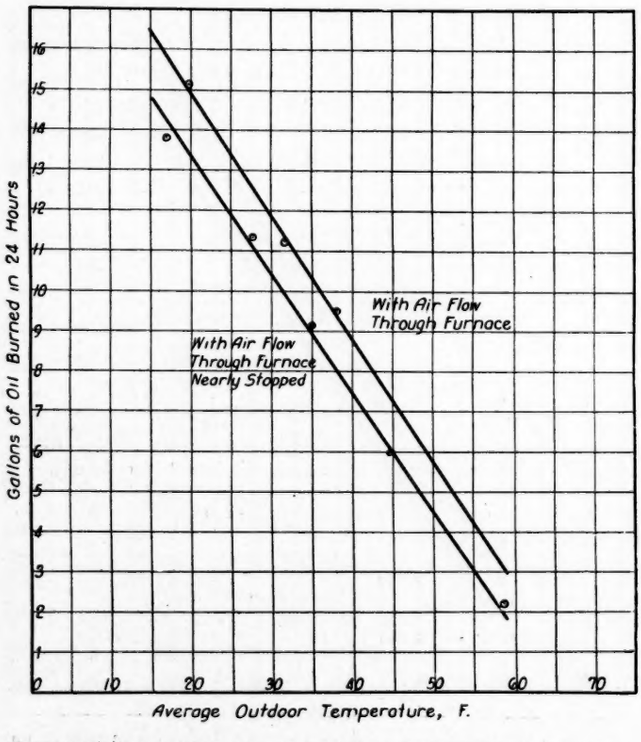
From the table it will be seen that a reduction of over 60% in the steam used is shown when the season of 1936-37 is compared with that of 1927-28. If the year of lowest consumption, 1931-32, is taken as the basis of comparison an even larger percentage of reduction in steam consumption is shown. It is also of interest to note that a considerable part of the saving took place after the latest modernizing of the plant was accomplished. Here is more evidence that the best of modern equipment with good and careful supervision can make savings which are well worth consideration by all building owners, managers, and plant operators.

Shutting the Air Off with the Fuel

THE data which are plotted on the accompanying chart were collected for the purpose of determining the advantage of closing the air discharge of a domestic oil burner fan when the burner shuts down.

In order to close the fan discharge on the burner a flapper damper was constructed in the fan discharge pipe, so that it remained open due to the air flowing through it while the burner was in operation, and closed when the burner shut down. The damper was sufficiently tight so that very little air leaked through it when closed. There was, however, the normal amount of air leakage around the heater doors which were not sealed.

The installation upon which the experiment was made is the one described by the writer in an article published in HEATING & VENTILATING, July, 1931, on page 74, entitled "Setting the Thermostat Back at Night." The upper line on the accompanying chart was drawn from data taken from that article. The data for the performance of the heating system when the air was shut off the burner were collected during the entire heating season of 1933-34. These data were collected in a similar manner and are comparable in every way because there were no changes made in the equipment, other than the installation of the automatic damper.



Fuel consumption versus outside temperature for two different conditions of air flow in the burner tested.

As may be seen from the chart, there is a saving of approximately one and one-quarter gallons of oil per day due to shutting off the air at the fan when the burner shuts down. In the case under discussion this amounts to approximately twelve per cent of the oil consumption.

The system from which the data were obtained consisted of a cast iron heater serving 1000 sq. ft. of hot water radiation. The burner was an Electrol model T, burning No. 2 oil with a 1.65 gal. per hr. tip.

On account of the low capacity nozzle serving 1000 sq. ft. of radiation, and further, due to the fact that the thermostat has a long range (3F or more) and is set back to 60F at night, the burner operates during long periods of time without shutting down.

For these reasons the writer is of the opinion that with a system where the burner runs frequently and for relatively short intervals of time, the saving would amount to considerably more than that shown on the chart.

As a rough check on the amount of heat lost by cooling down the combustion chamber, we may assume that there is a total thermal capacity in the firebox of approximately 100 B.t.u. per degree F, and that the mass is heated to a mean temperature of 670F, giving a total heat storage of 60,000 B.t.u. or roughly 0.4 gal. of oil. This heat is not all lost each time the burner shuts down, but the more cold air which is permitted to pass through the hot firebox, the more heat becomes unavailable to the heating system. Also the more frequent the operation of the burner, the greater the integrated loss.

There are many practical difficulties in applying an air shut-off to the average burner, but there may be some virtue in installing combustion chambers of relatively low thermal capacity, and insulating them well. —*Richard Brown.*

Underground Steam Main Conduits and Adjacent Ground Temperatures in St. Louis

By LEVEN D. GRAY†

ADVANCEMENT in the art of distributing steam through underground lines is an objective of every progressive central station or district heating company. In an effort to find less costly and more efficient means of distributing steam to its customers, the Union Electric Company of Missouri, operating a central station steam system in St. Louis, has made two different types of underground steam main installations within the last two years that vary in some respects from older types of installations. The purpose of this article is to give a brief description of these installations and to show certain ground temperature results, adjacent to these sections as indicated by thermocouples.

Fig. 1 indicates a cross-sectional view of a street under which is located a 20-in. high pressure steam main. The black dots indicate the location of thermocouples which are identified by numbers. Fig. 2 indicates a cross-sectional view of the steam conduit.

Several years ago a 6-in. water main, which runs parallel to the steam conduit, broke, causing water to fill the conduit and wash the insulation from the pipe line. An investigation indicated that the conduit was in fairly good condition, but if new sectional pipe covering were to be installed it would be necessary to remove and rebuild the top and at least one side of the conduit, while if cell-concrete insulation were installed it would be necessary to remove and replace only the top of the conduit, with correspondingly less excavation.

Although more cell-concrete would be required to fill in the conduit around the pipe, due to the size and shape of the conduit, than should normally be required, it was found that the overall cost of re-insulating the line with cell-concrete was slightly less than using sectional covering; also it was felt that such an installation would afford an excellent opportunity to study at first hand the value of using cell-concrete as an underground pipe insulation. Therefore, in July, 1936 the old ruined insulation was cleaned out of the conduit and cell-concrete installed.

Cell-concrete is a light weight cellular concrete of a specific gravity of approximately 0.3. It is made of neat portland cement and foam, prepared on the job and poured into the conduit. The myriads of tiny air cells, each an independent sealed structure, make it an effective heat insulator, and the fact that it is practically nothing but cement would indicate that it should be enduring and unaffected by normal destructive elements.

Thermocouples were placed in and around the conduit to determine the ground temperature conditions adjacent to the conduit, the drop in temperature across the cell-concrete and the tile walls. Thermocouple readings are taken about once a week. Table 1 shows the thermocouple temperatures in degrees Fahrenheit as recorded January 3, 1938 when the outside air temperature was 25F. It is interesting to note that the temperature drop between No. 7 and No. 6 is 206.8F where there is 0.28 ft. thickness cell-concrete, and the drop between No. 7 and No. 8 is 228.6F where there is 0.32 ft. thickness cell-concrete.

Fig. 3 indicates a cross-sectional view of a street under which the installation of a 10-in. high pressure steam main was completed in September, 1937. This main line was installed to supply the total steam requirements of the new U. S. Post Office building, which was then under construction.

The 4-in. drain tile under the 4-in. concrete base,

†Steam Distribution Engineer, Union Electric Company of Missouri.

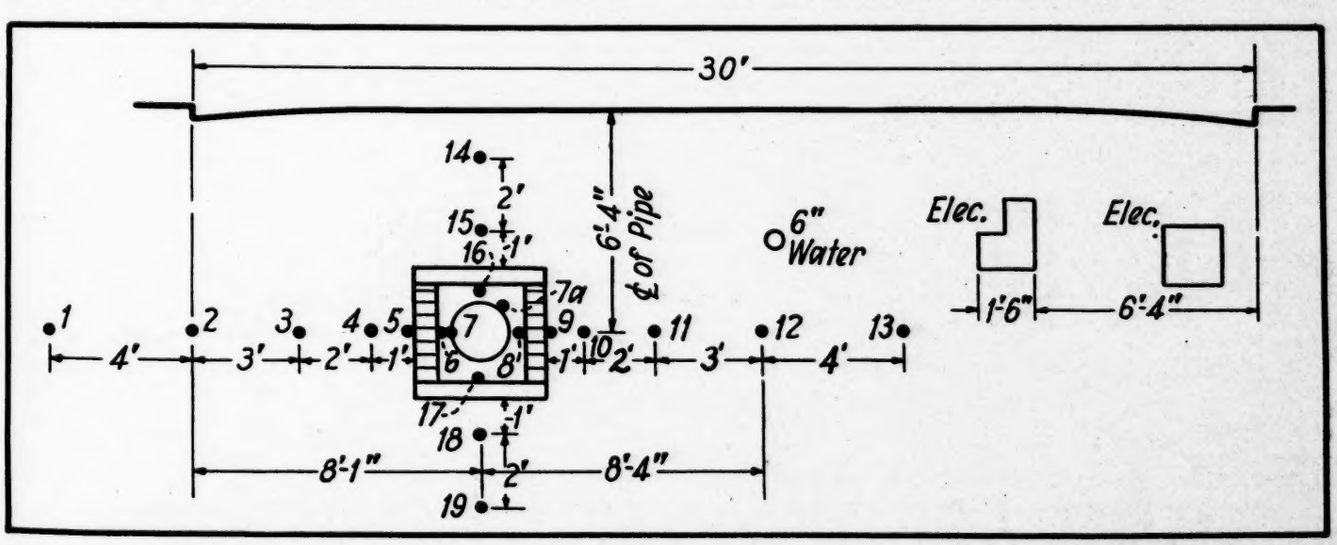


Fig. 1. Cross-section of street showing location of 20-in. high pressure steam main in conduit and of thermocouples.

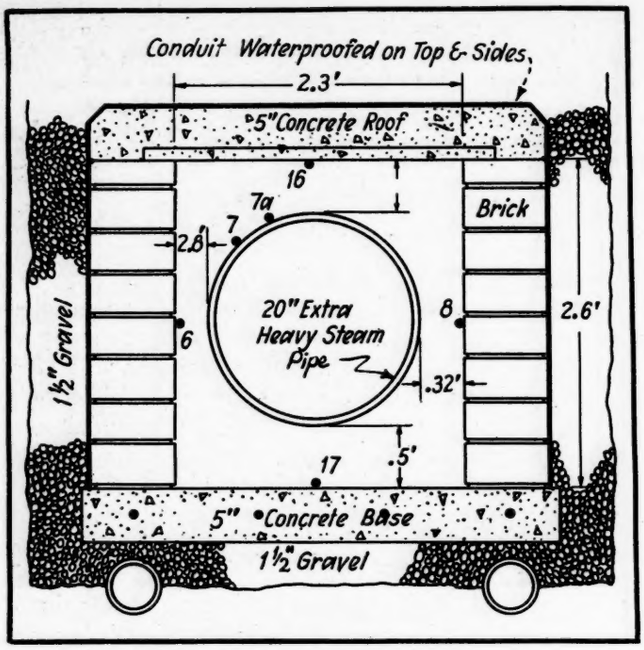


Fig. 2. Enlarged view of high pressure main and conduit shown in Fig. 1.

the gravel drainage under and along the sides of the conduit, the 10-in. extra heavy, welded steel pipe, the 3-in. thick, sponge-felt, laminated asbestos, waterproofed cover, pipe insulation, were similar to those used for many years for underground steam lines. The novel part of the installation is the air-stone, precast concrete conduit sections which were used because they could be installed quickly and at less installed cost than a built-up conduit made of multicell tile walls and concrete roof.

TABLE 1.—TEMPERATURES AROUND CONDUIT OF FIG. 1 AS MEASURED ON JANUARY 3, 1938, WHEN OUTSIDE AIR TEMPERATURE WAS 25F

Thermo-Couple Number	Temperature, Degrees F	Thermo-Couple Number	Temperature, Degrees F
1	77.0	10	109.4
2	84.4	11	92.7
3	98.1	12	75.9
4	115.3	13	67.3
5	134.4	14	68.9
6	188.4	15	95.5
7	395.2	16	123.4
7-a	385.7	17	144.3
8	166.6	18	119.3
9	129.7	19	103.3

Note: Thermocouple No. 7 is brazed to the 20 in. pipe and No. 7-a is held against the 20 in. pipe with a tie wire. It is assumed that the difference in recorded temperature is due to the difference in contacts.

TABLE 2.—TEMPERATURES AROUND CONDUIT OF FIG. 3 AS MEASURED ON JANUARY 3, 1938, WHEN OUTSIDE TEMPERATURE WAS 25F

Thermo-Couple Number	Temperature, Degrees F	Thermo-Couple Number	Temperature, Degrees F
1	384.4	11	158.4
2	167.2	12	140.7
3	157.6	13	104.4
4	144.3	14	83.7
5	120.7	15	66.2
6	100.2	16	51.4
7	89.6	17	44.1
8	78.8	18	149.0
9	67.3	19	109.8
10	62.8	20	90.7

Note: Thermocouple No. 1 is brazed to the pipe.

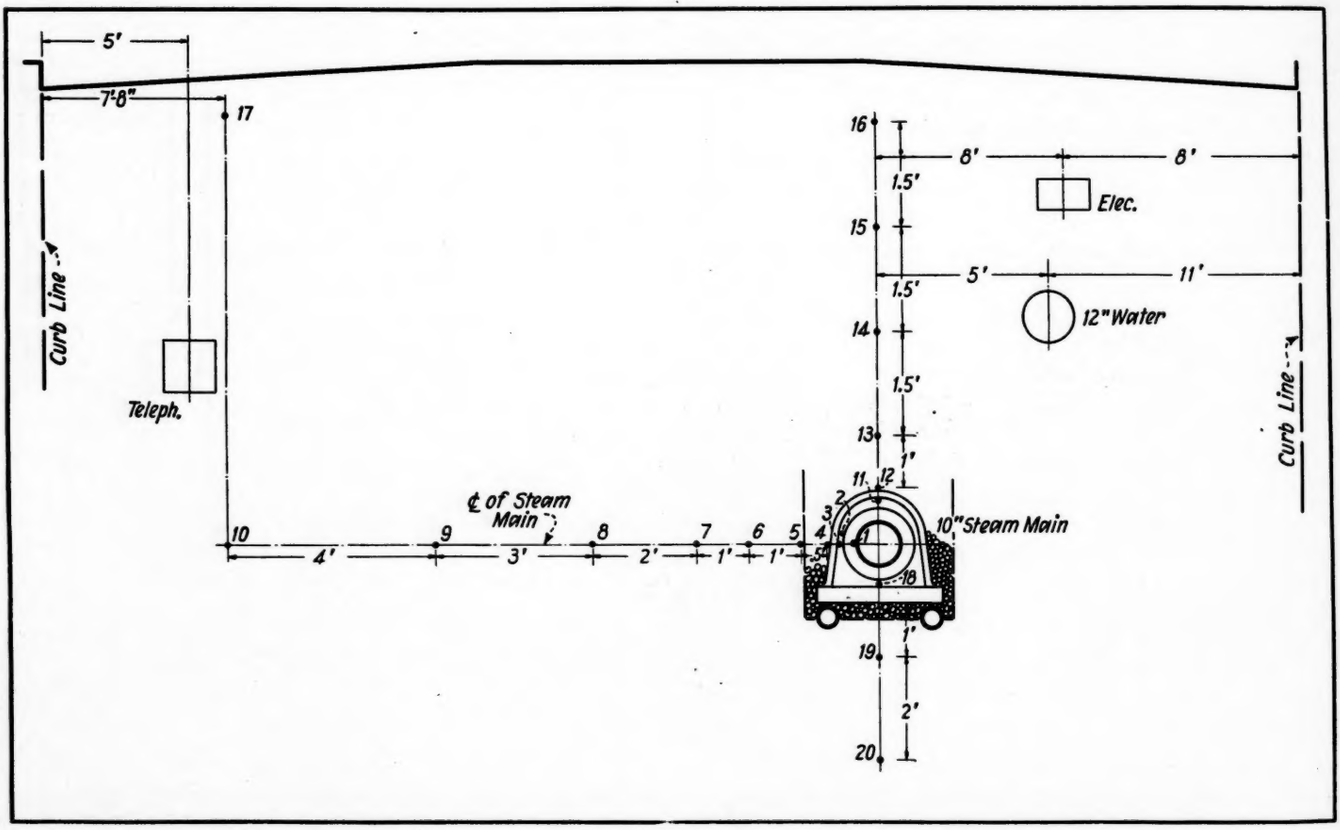


Fig. 3. Cross-section of street showing location of 10-in. steam main in conduit and of thermocouples.

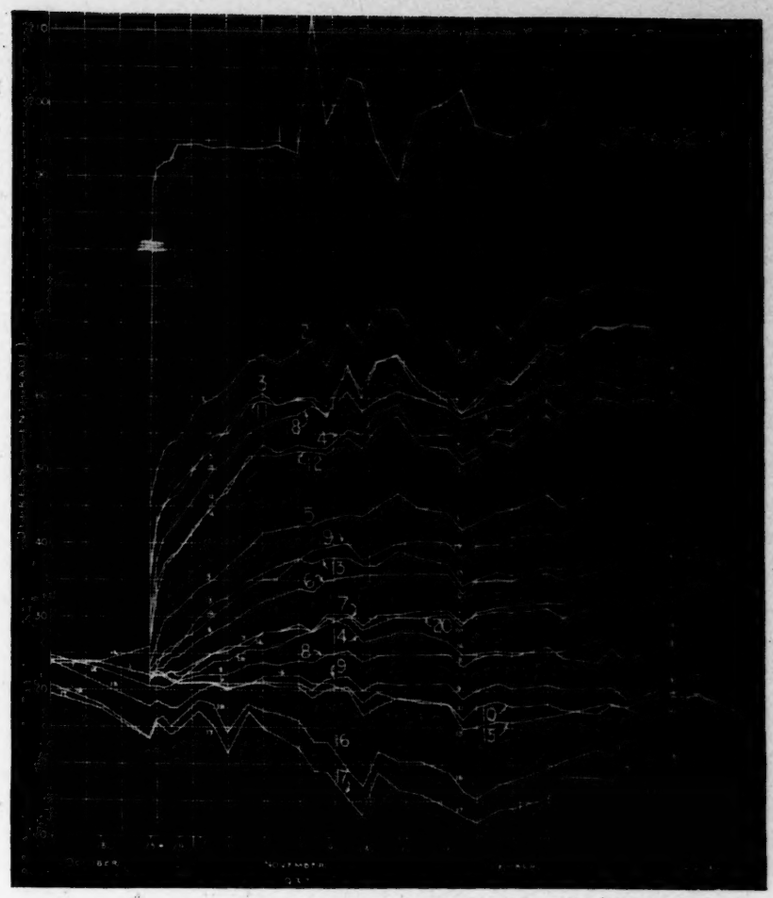


Fig. 4. Temperatures at thermocouple locations of Fig. 3 from October 11, 1937 to January 17, 1938. Curves connect points where temperatures were read. Temperatures between readings may not follow curves, but are problematical.

Thermocouples were fabricated from No. 16 lead covered copper-constantan wires and installed as indicated in Fig. 3. Each thermocouple was numbered for ready identification. They were installed only on one side of the conduit as there were no obstructions on that side and it was desirable to obtain adjacent ground temperatures in a section where there were no extraneous underground influences.

The steam main had been completed and the thermocouples installed by about October 1, 1937; however, steam was not turned on the line until October 25, 1937. On October 25 temperatures were measured immediately preceding the time when steam was turned on, then again seven hours later.

It is interesting to note from Fig. 4 the definite downward trend of temperatures as indicated by No. 16 and No. 17 from October 11 to December 10, then an upward trend from December 10 to January 17. The Weather Bureau reports show that the monthly mean temperature for October was 57.0F, precipitation, 3.51 in.; for November it was 42.1F, precipitation, 1.19 in.; for December it was 32.0F, precipitation, 3.91 in.; and for January it was 33.4F, precipitation, 0.48 in. Again it is interesting to note that after steam was turned on the line the temperatures at 1, 2, 3, 4, 5, 11 and 12 rose rapidly during the first three days, then rose at a slower rate until such time as they tended to follow the variations of the main line temperatures.

The cell-concrete installation is located about two miles from the air-stone conduit installation. At present there is little information as to the relative damp clay soil conditions at the two locations. Depths of conduits and adjacent underground structures are shown in Figs. 1 and 3. Table 2 shows the temperatures adjacent to the air-stone conduit as of January 3, 1938. Those readers who attempt to compare the temperatures at similar locations adjacent to the two conduits will have aroused many perplexing questions over which they can ponder some night when they are unable to sleep.

New Methods of Insulating and Protecting Steam Lines

INSULATION and protection of steam lines are two important factors in any plan for transporting steam underground for the heat losses must be minimized while the buried piping must not require major repair for long periods. That is why so much attention is paid to underground pipe protection and to insulation. Here are two statements, one describing a method of insulation and protection using a light metal casing around asphalt, while the other tells how fill insulation has been applied to existing underground lines in conduit.

A Positive Protection for Underground Piping

This is the title given to the following statement on the subject as prepared by H. G. Hill, Ehret Magnesia Manufacturing Company.

Buried underground piping, he states, especially where there are excessive moisture or flooding conditions, has always been a most serious problem. Unless proper protection is provided heavy losses will be suffered. Not only must moisture be definitely excluded but the destructive action of direct soil contact must be prevented.

Where insulation must be used for either hot or cold conditions, it is most important that the covering be kept dry. Furthermore, as the buried piping cannot be readily inspected there is always the possibility of unknown leakage and damage.

The method described here has been successfully used for upwards of ten years in the far west.

This system is completely applied to the pipe at the factory. When delivered to location the installation consists of making the connections and direct burying in the soil. Any lengths of pipe can be treated but it is recommended that maximum lengths be limited to twenty feet in order to facilitate handling.

The principle involved consists of encasing the piping, or the insulation covering around the piping, with a heavy layer of high melting point non-porous asphalt

The asphalt is poured hot into a sheet metal form which is spaced concentrically around the pipe or insulation. For all underground conditions the thickness of the asphalt casing is 1 in. for insulated piping and ½ in. for un-insulated piping. The insulation for pipes carrying heat should be 85% magnesia and for cold pipes either 85% magnesia or molded cork covering should be used. The thickness of the insulation will vary with the conditions.

When delivered to location there is sufficient bare pipe left protruding from each end so that the pipe ends can be properly joined by the pipe fitter or welder.

After the pipe lengths have been properly connected and the installation tested, the bare pipe at the connections is covered with insulation of the same type and thickness as the adjacent pipe, a sheet metal sleeve is fitted over the space and hot asphalt is poured in. The heat of the asphalt poured around these joints causes it to fuse into the asphalt of the adjacent pipes.

One especially interesting feature of this method is that little labor is necessary in making the field installation. Every pipe is individually treated. This permits any particular pipe to be worked at without disturbing or exposing other pipes which may run parallel to it.

Where it may be necessary to make changes in existing piping or to add new connections, such as branches, the operation is simple and can be done in a minimum of time. The procedure consists of cutting through the thin sheet metal casing and removing a strip of the desired width. The asphalt and magnesia is then easily cut through and removed leaving the pipe bare. When the work on the pipe is completed the insulation is replaced, and a sheet metal form is fitted around. Asphalt is then melted and poured into an opening in the top of the form, which finishes the work.

For pipes 2 in. in size and larger, support for the pipe is provided in 6-in. long blocks spaced at 6-ft. intervals along the pipe. These supporting blocks are molded from diatomaceous earth and Portland cement and have a high thermal insulation value. They are so made that they will conform to the pipe surface at the point of contact and reach entirely through the insulation and the asphalt protection.

If piping becomes worn out it can be replaced without sacrificing the magnesia or the asphalt. In such a case what is necessary is to completely cut through at distances equal to the length of the new pipe, spot weld the end of the new pipe to one end of the old pipe and then pull the old pipe out. The new length of pipe will be drawn through into position and the old length of pipe cut from it. Sufficient of the treatment should be removed from each end of each length to permit welding the new pipe ends together.

Reinsulation of Existing Underground Steam Lines

is the title under which D. W. Burnett, chief engineer, General Insulating & Manufacturing Company, tells of the use of a fill insulation. He writes: "Engineers have pondered the question, 'what can and what should be done to reduce the radiation losses in underground steam lines that were installed twenty or thirty years ago, due to the deterioration or falling away of the original pipe insulation?' Quite often the pipe and the conduit are in such condition as to give good service for many additional years, but the lack of good insulation on the pipe demands consideration.

A number of companies that operate underground steam lines have found that the pneumatic process of installing rock wool insulation is the answer to these questions. The conduit is filled around the pipe with granulated wool (heavily treated for waterproofing) by using the same blowing machine and equipment as is in common use for the application of rock wool insulating materials in residences and commercial buildings, and which is available in practically every city. Normally, the space between the pipe and the conduit is ample to receive about the right thickness of insulation, and an efficient reinsulation job can be done on old underground pipe lines in a few hours time at low cost.

The procedure normally followed when blowing the wool into underground conduits is first to push sectional rods, similar to the rods used by electric and telephone cable conduit crews, or a steel tape, through the conduit, on the top or along the side of the pipe, from one manhole to another manhole, then pull a heavy wire or rope back through the conduit. This work is often done by the company's underground steam line crew before the blowing equipment and crew are brought on the job.

Due to the old pipe insulation having fallen off the pipe and thereby creating obstructions over which the rods must pass, it is desirable to place a ball or cradle on the head end of the rods and to make the rods as stiff as possible in order more easily to push the rods through the conduit.

Where manholes are spaced too far apart to permit pulling a 2½-in. or 3-in. hose from one manhole to another manhole, or where there is an angle in the conduit, then it is necessary to make an excavation about four feet long, midway between manholes, opening the top of the conduit so that the hose can be handled at such a point. The amount of open space between the pipe and the conduit, also the nature of the obstructions in the conduit, are factors that influence the length of conduit that can be filled without making excavations. Conduit runs as long as 125 ft. between manholes have been filled by one company without making an excavation.

After the wire has been pulled through the conduit the wool blowing machine and crew are brought on the job, and with the help of the underground crew a 2½-in. or 3-in. hose is pulled through the conduit and attached to the blowing machine. The wire trails back through the conduit as the hose is withdrawn, just as a precaution in case the hose clogs up and has to be temporarily withdrawn. The far end of the conduit is blocked closed after the hose has been withdrawn about two feet from this far end, and wool is blown in the conduit until the pressure gage located on the blower indicates about 3 lb.; then the hose is withdrawn another one or two feet and halted until the pressure gage again indicates about 3 lb. While a pressure gage is desirable, an experienced applicating crew can judge correctly when the space available is filled and packed to approximately the right density. This procedure is followed until the entire conduit is filled.

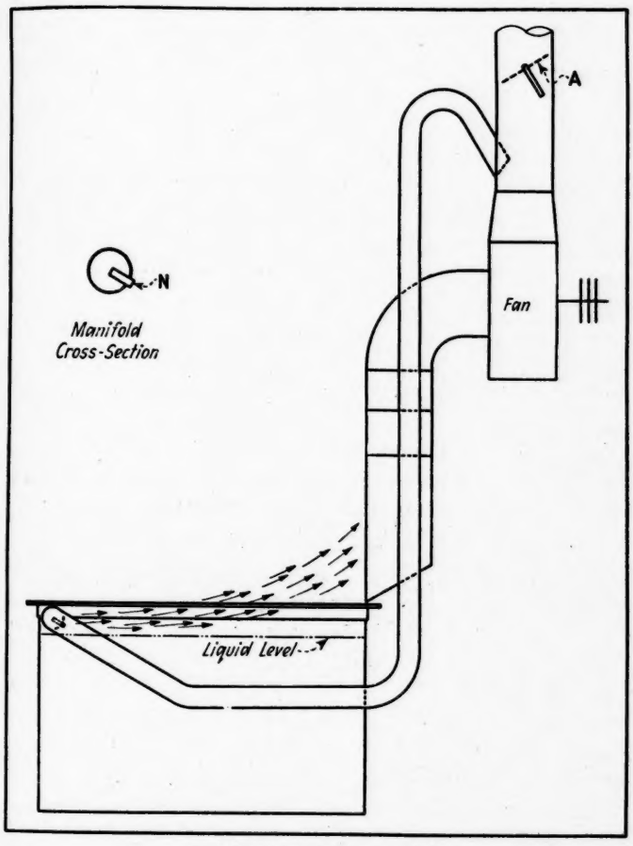
KINKS

An Aid in Open Tank Ventilation

Engineering is often subject to the force of habit. Mention a ventilating hood over a tank and the engineer's immediate picture is of a suction hood connected to a fan with a discharge stack. A tank ventilating system does not necessarily have to be all on the suction side of a fan. It can easily be a good combination of both suction and blowing. However, habit, it is; and, as is usually the case, it is broken by necessity. The following describes how a habit was broken and a new approach to ventilating tanks revealed.

A hot sulphuric acid tank was being used for treating automotive parts which were lowered into the tank by use of a traveling hoist and baskets. The tank was ventilated by an ordinary vertical opening side-hood allowing for basket and hoist clearance. The ventilation worked satisfactorily until another piece of ventilating equipment was started up in an adjacent room. This new equipment robbed the building of air and rendered the acid tank ventilation useless. The plant engineering department immediately started action to correct the situation.

The day shift went home and the night shift came on. The cool night air seemed to intensify the sulphuric acid fumes. The atmosphere became unbearable; something had to be done. A desk fan was procured from the superintendent's office and placed on a box so as to blow the fumes away from the operator. Everything worked out very nicely. The fan apparently was just the right size, set in just the right position, and the air blast struck the tank at just the right angle.



Ventilation of open tank

The superintendent had to have his fan back so other arrangements had to be made. However, the fan had given us an idea which we proposed to develop. A steel pipe with ⅛-in. holes along one side was installed along the front edge of the tank. Compressed air of varying pressures was played with. It was found that the amount of air necessary for the desired effect was quite small. The final results were pleasing.

The accompanying sketch shows the final arrangement. A standard steel pipe, 2½-in. diameter, was used as a manifold with ¼-in. pipe nozzles spaced on 8-in. centers. This manifold was connected by sheet metal duct to the discharge side of the already existing ventilating fan. The damper A was installed in the discharge stack to control the flow of air through the nozzles N. By shutting the damper, resistance forces the air into the manifold branch. The adjustment of this damper was found to be rather sensitive as there must be just enough force to the jets to bend the fumes toward the hood inlet and not enough to disturb the hood suction performance.

This arrangement proved very satisfactory. Its success has been even more gratifying on other installations where conditions are normal. It does not cost any more for power. Power consumption is proportional to the volume of air handled against a given constant resistance; or, proportional to a varying resistance with a given constant volume. In this case, the damper A increases the resistance but the volume falls off compensatingly. Actually, the total economic efficiency shows a gain consisting of the amount of heat saved by the small reduction in the amount of air being exhausted from the building.—*J. M. Newman, Lansing, Mich.*

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Liberal payment will be made for brief articles which are, in the opinion of the editors, useful and generally applicable kinks relating to drafting room, shop, plant, or field practice in the design, installation, operation, or maintenance of heating, ventilating, or air conditioning equipment. Sketches (in pencil) or photos should be included when necessary.

THE PROBLEM CORNER

A heating contractor told two of his men, Frank and Joe, to start in the morning making radiator connections in two new houses. The houses both had the same number and type of radiators, so the men drew lots to see which house they would work on. Joe arrived first the next morning and had three already made when Frank got there and pointed out that Joe was working in the wrong house. Joe then went to the other house and started there while Frank began with the next radiator. Frank finished the work in his house before Joe, then went over to the other house and finished six connections in that house by the time Joe had the rest done. How many more connections did Frank install than Joe in all?

If you are doubtful of your solution, see page 70.

Day and Night Temperature Differences in Summer in Washington, D. C.

By MARY O. SOROKA

Cooling by the use of night air is a method which has gained increasing popularity. Studies of the temperature difference between day and night periods have been made, but not in all parts of the country. The material presented in this article, covering Washington, is based on data collected by the author and Robert B. P. Crawford, air conditioning engineer of Washington, D. C.

IN spring or early summer weather the necessary cooling indoors might be done with little if any refrigeration of the air. The nights are cool at that time of the year and if the house has been heated up during the day it could be cooled by bringing in the cool air during the night.

During clear nights the surface of the earth, including vegetation and other objects, loses much heat by radiation and thus both it and the air in contact with it are reduced to lower temperatures; obviously the effect is more pronounced the gentler the winds. After the dewpoint has been reached, all further loss of heat now produces a much smaller proportionate decrease of temperature and results in the deposition of dew at temperatures above freezing. The stratification of the air outside becomes as marked as the stratification in a room. The lower layers of the quiet atmosphere tend to take on the temperature of the ground. Such differences do not occur in an active atmosphere since a breeze will quickly level any marked differences in temperature.

There is a substantial difference between the lowest and the highest temperatures of the day and the difference is greatest on clear days. Cloudiness reduces the daily range of temperature to less than one-half that on a clear day. On a rainy day the difference between the maximum and minimum is only 2F or 3F.

The temperature differential occurring on clear days might be capitalized for residences which cannot afford air conditioning but which could afford an attic fan to circulate the night air through the house. This has the effect of cooling the walls and furnishings and dissipating heat which accumulates in the daytime. Business structures could also be cooled or at least maintained at the daytime conditioned air temperature by circulating the night air.

It will be seen from Table 1 that in Washington, D. C., the minimum temperature at night during the cooling season occurs most often at 5 a.m.; next in frequency is 6 a.m., and third is midnight. This information is also shown graphically on the following page for each of the summer months. Table 2 shows the average temperature difference between maximum daytime and minimum night-time temperature is 19.3F during the same period.

TABLE 1.—HOUR OF OCCURRENCE OF MINIMUM NIGHT-TIME TEMPERATURES

(Figures are totals for all days requiring cooling for the years 1928 to 34, inclusive)

Hour	Number
8 p.m.	2
9	9
10	13
11	30
12 midnight	160
1 a.m.	42
2	40
3	72
4	124
5	269
6	166

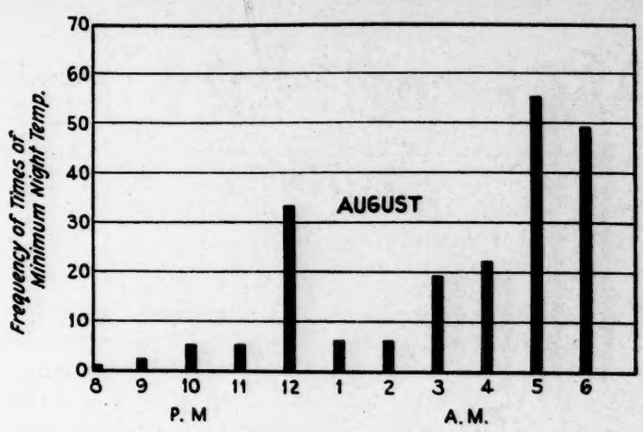
TABLE 2.—AVERAGE DIFFERENCE BETWEEN MAXIMUM DAY AND MINIMUM NIGHT TEMPERATURES FOR DAYS REQUIRING COOLING (i.e. ABOVE 55F DEWPOINT)

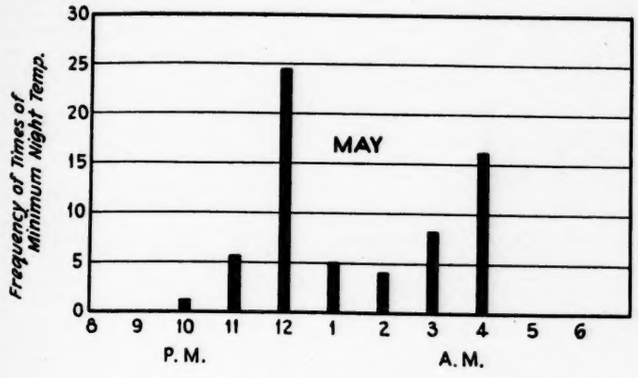
Year	May	June	July	August	September	October
1928	20.7	16.6	18.6	17.5	17.1	20.0
1929	20.7	20.7	20.2	18.4	21.9	18.4
1930	21.8	20.5	22.4	21.8	21.6	19.0
1931	19.5	18.8	18.4	17.0	20.2	22.2
1932	23.3	18.7	18.8	20.9	18.3	14.1
1933	18.5	21.8	18.3	16.4	17.3	24.5
1934	21.1	19.3	18.5	16.5	14.8	15.7
Average	20.8	19.5	19.3	18.3	18.7	19.1

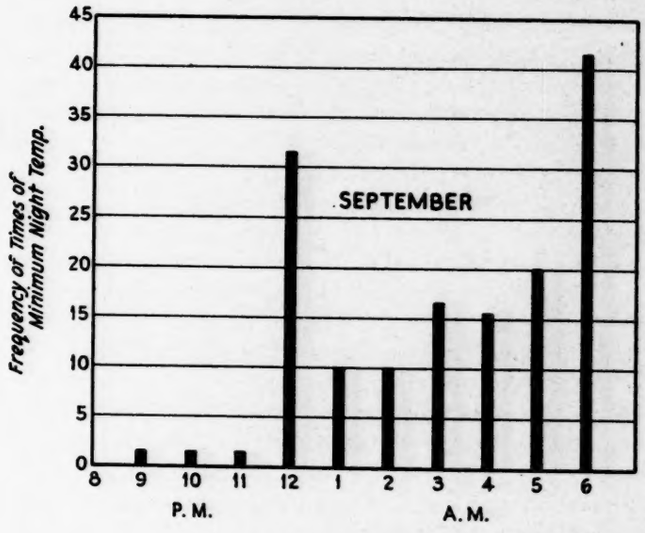
19.3F = Average temperature difference between maximum daytime and minimum night-time temperatures.

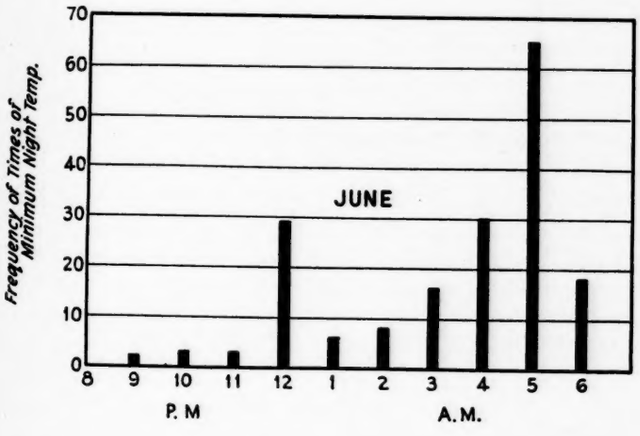
Coolest Hour at Night

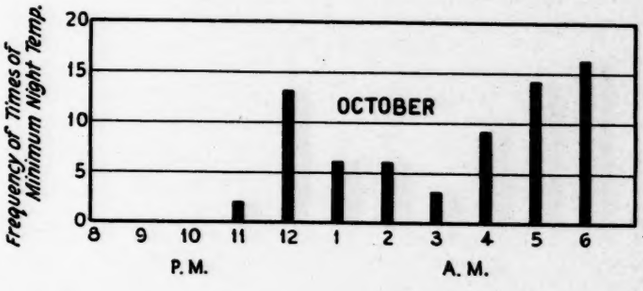
The accompanying frequency charts show the number of times that the minimum night-time temperature occurs at a given hour. The count covers all days requiring cooling from 1928 to 1934, inclusive

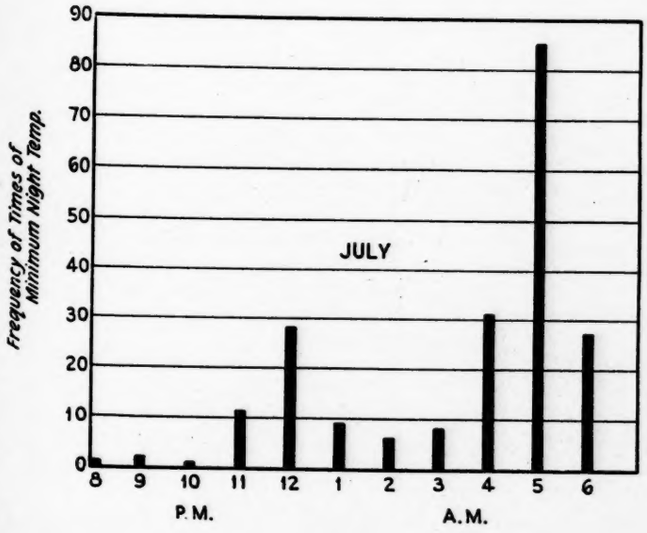


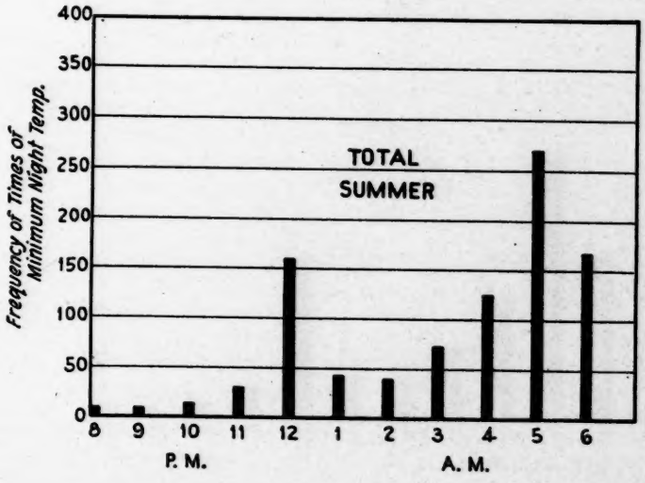












WHAT READERS SAY• • •

More About Eliminating Rust Troubles in Hot Water Supply Systems

In the April issue of HEATING & VENTILATING on page 44 you give two methods of removing rusty water. The first method is by the use of a bituminous base paint. The second method is by the use of a sodium silicate solution. Will you please advise me how I can prepare a solution for a tank 30 in. in diameter by 8 ft. long, and how much solution I would need? Will you also advise me whether these methods of prevention of rusty water will also prevent further rusting? *J.K.*

Regarding the sodium silicate method for eliminating rusty hot water troubles, the silicate is applied in small quantity over an extended period of time, so that the water will not be overdosed, but be supplied with just enough to clear up the rusty color in the water. To accomplish this you need a chamber in which the silicate, which comes in crystals, can be stored. It may be held in a wire basket inside the chamber, with at least a ½-in. clearance all around and under the basket, for hot water to circulate down through the chamber, and pick up some solution from the slowly dissolving crystals. The water so impregnated with sodium silicate is circulated into the hot water tank, and does its work there by covering the rusted wall of the tank with a film which separates the metal from the water. By that separation the water remains clear as long as the film is intact. That is the theory and it is the way that it works out where water conditions are not antagonistic to film formation and retention.

In Fig. 1 we submit two typical methods for installing the chamber. At (A) the conditions are such that the chamber circulating connections should be made to the tank direct. Hot water coming into the chamber from top of tank, circulates around and through between the crystals in the wire basket. From bottom of chamber the solution falls by gravity and enters bottom of tank, where it becomes mixed throughout the tank by local circulation within the tank which is set up by the submerged heater coil. In this way the entire inner surface of tank becomes affected by the solution.

In cases where the water heating element is exterior to the tank the arrangement shown in sketch (B) Fig. 1, may be used very successfully. Instead of recirculating from chamber to tank as in sketch (A) this one recirculates into the hot water flow pipe from heater to tank. By this method a higher temperature prevails in the chamber which makes the crystal dissolving process more active than in sketch (A) where the chamber temperature is lower.

No matter which position the chamber may be installed in, it is necessary to valve it correctly. The chamber has to be recharged from time to time, probably every six months or a year, according to size of chamber and water demand. Also it must be thoroughly flushed out every time it is recharged, and sometimes in between recharging periods. The method of valving shown meets these requirements. Sodium silicate chambers are a patented article.

This method may not exactly prevent further corrosion of the tank but it will retard it, which means a longer life to the tank. •

Water for Air Conditioning

In the May issue a request was made to readers for information about air conditioning installations in which cooling water was taken from city mains and then returned to the mains. One installation was reported from an Illinois city where water was pumped back into the mains after passing through the condenser, but this plan either has been or will be abandoned in this installation.

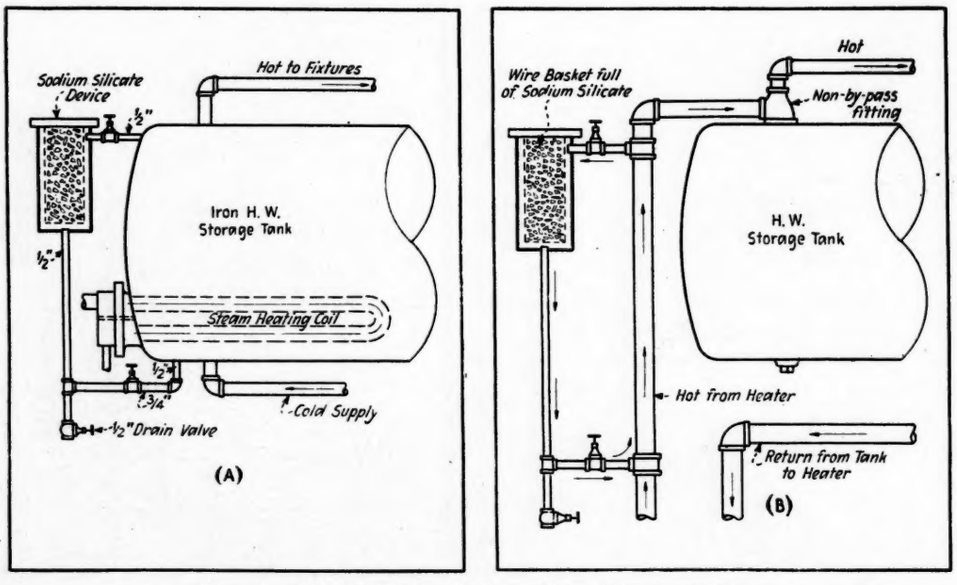


Fig. 1. Two methods for installing silicate chamber

An installation of this kind is also reported from an Oklahoma city where the water temperature increased 3½F. In regard to this method of cooling condenser water the point has been raised that this scheme could only be followed by a few customers on a main to the disadvantage of all the other customers on the main. The question also arises as to how the water company would be remunerated, as there is little water actually used. One method which has been proposed is that the customer pay for water on the basis of the number of B.t.u. absorbed.

Frost Penetration in Ground

In construction work it is occasionally desirable to know the depth to which frost may be expected to penetrate the ground in a given locality. Either or both of two figures may be useful—the maximum depth to which frost has been known to penetrate, and the average depth it may be expected to penetrate.

Usefulness of Data

In addition to the usefulness of these data in connection with such work as determining depths of pipe lines, they also give some clues to ground temperatures in winter. The temperature of the ground is often a matter of concern in estimating heat losses from heated spaces adjacent to ground. Below the depth to which frost penetrates the ground is above 32F in temperature, while above this depth the temperature follows a gradient to the surface where air temperatures prevail.

The depth to which frost penetrates the ground depends on the character of the soil, winter temperatures, and the extent of sustained low temperatures. It would seem, and preliminary study tends to support the idea, that the depth frost penetrates may vary with the number of degree-days on a 32F base.

Maximum Depth of Penetration

The accompanying map, and the table facing it, show the extreme condition; that is, the greatest depth to which frost penetrated, so far as available records indicate. This figure is, in its way, somewhat similar to the lowest temperature of record, since it represents the extreme.

The Map

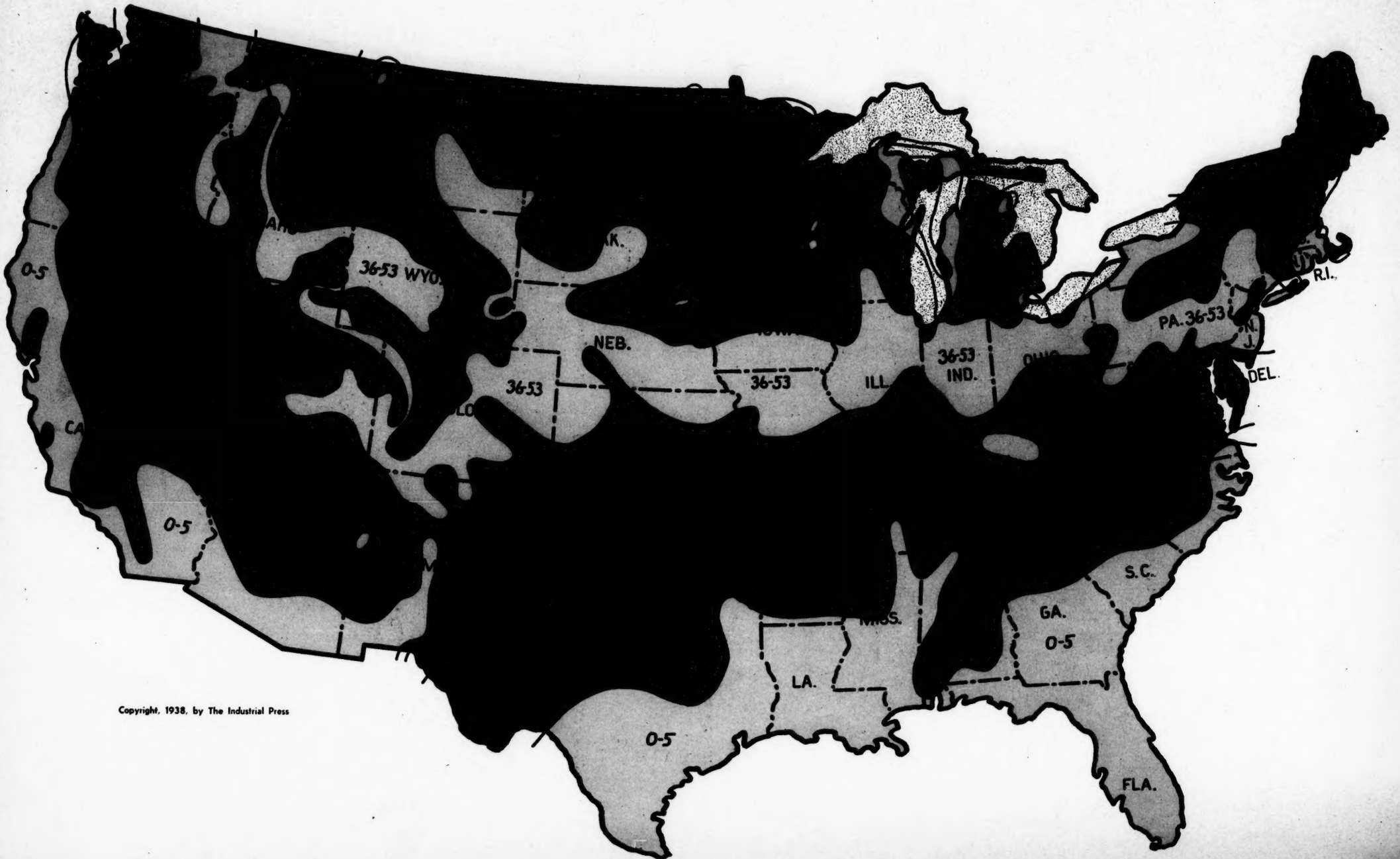
The map is plotted from several hundred points for which data are available through the courtesy of the U. S. Weather Bureau, and covering every state except Arkansas. Consequently, the map is believed to be reasonably accurate excepting in the Rocky Mountain regions where few climatic maps are highly accurate.

The Tables

The table for 100 cities covers that number of important localities. These cities are not in all cases the same cities as have appeared in previous tables of this series of maps due to the unavailability of data.

Table 1 is also based on data from the Weather Bureau but is not in all cases extremely accurate since there has been a fair amount of interpolation and some extrapolation from the available figures. However, the figures are undoubtedly as accurate as are needed for construction and estimating purposes.

MAXIMUM DEPTH OF FROST PENETRATION IN INCHES



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MAXIMUM FROST PENETRATION (INCHES) IN GROUND IN 100 CITIES

City	Depth, Inches	City	Depth, Inches
Albany, New York	48	Lincoln, Nebraska	36
Albuquerque, New Mexico	4	Los Angeles, California	2
Atlanta, Georgia	6	Louisville, Kentucky	5
Baltimore, Maryland	20	Marquette, Michigan	24
Binghamton, New York	72	Memphis, Tennessee	20
Birmingham, Alabama	12	Milwaukee, Wisconsin	60
Bismarck, North Dakota	84	Minneapolis, Minnesota	108
Boise, Idaho	42	Missoula, Montana	84
Boone, Iowa	60	Mobile, Alabama	6
Boston, Massachusetts	48	Monroe, Louisiana	8
Buffalo, New York	48	New Orleans, Louisiana	2
Burlington, Vermont	66	Newport News, Virginia	4
Butte, Montana	84	New York, New York	42
Cedar Rapids, Iowa	60	Ogdensburg, New York	72
Charleston, South Carolina	2	Ogden, Utah	48
Charlotte, North Carolina	8	Oklahoma City, Oklahoma	22
Chattanooga, Tennessee	15	Paducah, Kentucky	11
Cheyenne, Wyoming	60	Pensacola, Florida	3
Chicago, Illinois	48	Peoria, Illinois	48
Cleveland, Ohio	60	Philadelphia, Pennsylvania	40
Columbia, South Carolina	4	Phillipsburg, New Jersey	32
Columbus, Ohio	30	Pierre, South Dakota	48
Concord, New Hampshire	66	Pittsburgh, Pennsylvania	24
Dallas, Texas	12	Pittsfield, Massachusetts	96
Denver, Colorado	60	Portland, Maine	72
Dayton, Ohio	36	Portland, Oregon	6
Detroit, Michigan	48	Prescott, Arizona	24
Dover, Delaware	18	Providence, Rhode Island	60
Duluth, Minnesota	96	Pueblo, Colorado	36
El Paso, Texas	18	Richmond, Virginia	24
Eugene, Oregon	8	Rochester, New York	48
Flagstaff, Arizona	20	Sacramento, California	2
Fort Wayne, Indiana	40	Salina, Kansas	24
Frederick, Maryland	24	Salt Lake City, Utah	34
Grand Canyon, Arizona	6	San Antonio, Texas	5
Grand Forks, North Dakota	84	San Diego, California	2
Grand Island, Nebraska	36	Savannah, Georgia	2
Grand Rapids, Michigan	58	Scranton, Pennsylvania	60
Green Bay, Wisconsin	60	Seattle, Washington	26
Greensboro, North Carolina	10	Shreveport, Louisiana	4
Harrisburg, Pennsylvania	48	South Bend, Indiana	48
Hartford, Connecticut	66	Spokane, Washington	66
Houston, Texas	3	Springfield, Illinois	48
Huntington, West Virginia	30	Springfield, Missouri	20
Indianapolis, Indiana	48	Syracuse, New York	48
Jacksonville, Florida	2	Tulsa, Oklahoma	16
Johnstown, Pennsylvania	48	Urbana, Illinois	33
Kansas City, Missouri	25	Washington, District of Columbia	18
Knoxville, Tennessee	9	Wheeling, West Virginia	36
Lafayette, Indiana	47	Williamsport, Pennsylvania	48

TABLE 1—AVERAGE FROST PENETRATION, INCHES (APPROXIMATE)

ALABAMA	
Birmingham	3
Mobile	1
Montgomery	2
ARIZONA	
Flagstaff	13
Globe	2
Phoenix	0
ARKANSAS	
Fort Smith	12
Little Rock	4
CALIFORNIA	
Eureka	3
Red Bluff	2
Sacramento	2
San Diego	1
San Francisco	1
San Jose	1
Stockton	2
COLORADO	
Boulder	20
Denver	24
Durango	18
Fort Collins	36
Grand Junction	18
Greeley	24
Leadville	66
CONNECTICUT	
Bridgeport	21
Hartford	30
New Haven	23
DELAWARE	
Dover	8
Wilmington	11
DISTRICT OF COLUMBIA	
Washington	10
GEORGIA	
Athens	3
Atlanta	3
Columbus	2
Macon	2
Rome	5
Savannah, less than	1
IDAHO	
Boise	15
Lewiston	8
Pocatello	30
Twin Falls	12
ILLINOIS	
Aurora	33
Bloomington	25
Cairo	6
Chicago	35
Decatur	20
Peoria	26
Quincy	22
Rock Island	32
Springfield	20
Urbana	22
INDIANA	
Elkhart	29
Evansville	7
Indianapolis	20
Lafayette	22
Marion	20
Michigan City	30
Richmond	15
South Bend	30
Terre Haute	20
Vincennes	10
IOWA	
Cedar Rapids	35
Clinton	33
Council Bluffs	30
Davenport	32
Des Moines	32
Dubuque	26
Fort Dodge	33
Sioux City	35
KANSAS	
Atchison	20
Emporia	12
Hutchinson	13
Leavenworth	16
Salina	17
Topeka	14
Wichita	11
KENTUCKY	
Bowling Green	5
Frankfort	10
Louisville	10
Owensboro	6
Paducah	5
LOUISIANA	
Baton Rouge, less than	1
New Orleans, less than	1
Shreveport	2
MAINE	
Eastport	36
Lewiston	54
Portland	48
MARYLAND	
Annapolis	10
Baltimore	12
Frederick	16
Hagerstown	18
MASSACHUSETTS	
Boston	36
MICHIGAN	
Alpena	24
Battle Creek	42
Detroit	36
Grand Rapids	36
Ironwood	36
Lansing	25
Marquette	9
Saginaw	42
Sault Ste. Marie	10
MINNESOTA	
Duluth	41
International Falls	66
Manketo	39
Minneapolis	66
Moorhead	51
Winona	41
MISSISSIPPI	
Corinth	3
Natchez	1
Vicksburg	2
MISSOURI	
Hannibal	20
Kansas City	15
St. Joseph	20
St. Louis	13
Springfield	8
MONTANA	
Anaconda	60
Butte	60
Great Falls	36
Helena	66
Kalispell	6
NEBRASKA	
Hastings	30
Lincoln	27
North Platte	22
Omaha	30
Sidney	33
NEVADA	
Carson	13
Elko	10
Reno	17
Tonopah	27
NEW JERSEY	
Atlantic City	6
Newark	17
Trenton	12
NEW MEXICO	
Albuquerque	6
Roswell	3
Santa Fe	27
Silver City	4
NEW YORK	
Kingston	32
Newburgh	22
New York	17
Poughkeepsie	25
NORTH CAROLINA	
Asheville	10
Charlotte	5
Raleigh	4
NORTH DAKOTA	
Bismarck	60
Dickinson	48
Fargo	54
Jamestown	54
Minot	48
OHIO	
Akron	15
Cincinnati	9
Cleveland	22
Columbus	10
Dayton	10
Toledo	23
OKLAHOMA	
Guthrie	8
McAlester	6
Oklahoma City	7
OREGON	
Ashland	1
Ontario	12
Pendleton	7
Portland	2
PENNSYLVANIA	
Easton	15
Erie	30
Harrisburg	19
Johnstown	15
Philadelphia	11
Pittsburgh	15
Reading	14
RHODE ISLAND	
Newport	26
Providence	26
SOUTH CAROLINA	
Charleston, less than	1
Columbia	2
Greenville	5
SOUTH DAKOTA	
Aberdeen	30
Pierre	37
Sioux Falls	40
TENNESSEE	
Chattanooga	6
Knoxville	8
Memphis	3
Nashville	5
TEXAS	
Dallas	3
El Paso	2
Fort Worth	4
Houston, less than	1
San Antonio	1
UTAH	
Logan	24
Nephi	16
Ogden	12
Salt Lake City	18
VIRGINIA	
Lynchburg	5
Norfolk	3
Richmond	4
Roanoke	10
WASHINGTON	
Astoria	1
Seattle	5
Spokane	24
Tacoma	4
Walla Walla	7
WEST VIRGINIA	
Bluefield	15
Charleston	10
Huntington	8
Parkersburg	9
Wheeling	12
WISCONSIN	
Green Bay	24
Madison	42
Milwaukee	42
Racine	40
Superior	48
WYOMING	
Cheyenne	24
Sheridan	26
Yellowstone	48

INDUSTRIAL EXHAUST VENTILATION

Air Cleaning Plant

By JOHN L. ALDEN

THE function of the dust separator in an exhaust system is to clean the air returned to the atmosphere to the degree of cleanlinesss which will fulfill the purpose for which the system is installed. Thus, in a system designed to recover valuable wastes, the justifiable thoroughness of cleaning is regulated by the balance between the value of the material collected and the cost of recovery. When abatement of neighborhood nuisance is the principal purpose of a dust collecting system, the air cleaner must remove all or nearly all of the dust particles visible to the naked eye which would otherwise reach the zone of complaint. If the purpose of the system is to eliminate a health hazard, the separator must clean to a degree which will avoid dangerous recontamination of breathing zone air.

So much emphasis has been placed on the removal of high fractions, 99% and more, of the dusts of hazardous dimensions, that there is danger of forgetting the economic side of dust control. It should be remembered that the cost of air cleaning increases with decreased particle size and with increased percentage removal. Just as it is foolish to install inadequate equipment, it is equally unwise to burden a factory with the cost of an unnecessarily refined cleaning system.

Preferred Characteristics of Air Cleaning Plants

Although no single type of dust separator embodies all virtues, the following characteristics are desirable:

1. The dust concentration in the cleaned air stream should be below the predetermined permissible limit.
2. It should retain its cleaning efficiency throughout its life.
3. Its cleaning efficiency should be substantially constant throughout its daily operating cycle.
4. Its cleaning efficiency should be nearly independent of the rate of air flow and the entering dust concentration.
5. It should require no shut-downs for cleaning or routine maintenance during normal working hours.
6. Normal maintenance and periodic disposal of collected dust should introduce no new health or fire hazard.
7. It should embody the usual elements of low cost, durability, minimum maintenance, minimum space and the other factors which purchasers expect of all factory equipment.

Cleaning Efficiency

No great significance can be attached to the usual expression of cleaning efficiency wherein the weight of dust collected is compared with the weight of dust fed to the separator. The true criterion of separator quality is more nearly the degree of contamination of the cleaned air either by dust count or by weight of solids per unit air volume. To illustrate, a small cyclone received ground corn from a hammer mill at the rate of 16,000 lb. per hr. The separating efficiency exceeded 99.5%, yet the quantity of dust was intolerable. More than a pound per minute of flour-like powder was discharged from the air outlet at a concentration of 8 grains per cu. ft. This dust loading *after* cleaning is greater than that in most factory exhaust systems *before* cleaning. It is evident that if the usual cleaning efficiency figures are to be used, they must be weighted in accordance with the dust concentration of the entering air. Thus, high dust loadings require greater separating efficiency to reach a given discharge cleanliness level than do lower loadings.

Recirculation of Exhaust Air

There is no air cleaning requirement more severe than that imposed by the return to workrooms of exhaust air. The discharge from a system collecting abrasive dust must be cleaned to a degree approaching street air. Recirculation demands the best of engineering, a constant check of breathing zone dust and the most thorough and conscientious routine maintenance. The danger of recontamination is always present. Heat conservation is the impelling motive for most recirculating systems. Before deciding on such a system, the cost of the necessary precautions against recontamination should be weighed against the reduction of heating cost. Although the author has engineered more than twenty systems of this type, he is strongly opposed to the recirculation of exhaust air unless all conditions are unusually favorable and can be counted on to remain so. Under no circumstances should a system of this type be installed in a plant without an adequate technically trained permanent staff.

Location of Cleaned Air Discharge

The location of the cleaned air discharge from an exhaust system often controls the thoroughness of cleaning necessary to prevent nuisance or objectionable atmospheric contamination. Favorable location of the discharge pipe sometimes permits the use of less refined and therefore cheaper cleaning methods. In general, the higher the point of discharge and the more remote from occupied areas, the less is the danger to health and property. Dusts of hazardous dimensions settle so

TABLE 14. APPROXIMATE MINIMUM PARTICLE SIZE FOR WHICH VARIOUS SEPARATOR TYPES ARE SUITABLE.

Separator Type	Minimum Particle Size, Microns
Gravity	200
Inertial	50-150
Centrifugal	
Large diameter cyclone	40-60
Small diameter cyclone	20-30
Fan type	15-30
Filter	0.5
Scrubber	0.5-2.0
Electrical	0.001-1.0

slowly that from an elevated discharge any breeze whatever will disperse them widely and render their concentration harmless by dilution.

In general, nuisance dusts are those large enough to be visible to the naked eye. The usual lower limit of size is about 35 microns, depending somewhat upon the color and smudging character of the dust. Because of their more rapid rate of fall, the discharge stack must be high or the separator must have high cleaning efficiency in this size range. Conspicuous dust clouds are an invitation for neighborhood complaints.

The discharge pipe should terminate well above the roof line. It should be so located that down-drafts on the leeward side of the building do not carry heavy dust concentrations into open windows. In no event should the separator be hung from the building wall with its outlet at window level. Neither should it discharge into courts or air wells.

Types of Dust Separators

The principal types of industrial dust arresting devices are:

1. Gravity chambers,
2. Centrifugal or inertial separators,
3. Filters,
4. Wet scrubbers, and
5. Electrostatic precipitators.

Intermediate types may employ a combination of operating principles as illustrated by gravity-inertial settling chambers or centrifugal air washers. The cleaning plant may consist of a single dust-removing device or of two or more cleaners in sequence. The two cleaners of a tandem pair are selected for their ability to perform complementary functions. The first cleaner, usually a cyclone or gravity separator, removes the larger and heavier constituents comprising the major dust loading by weight, whereas the second takes out the finer particles which constitute the majority by count of particles.

Characteristics of Dust Separators

Table 14 lists the more common type of dust separators together with the minimum particle size for which each type may be considered suitable. This table must be used with discretion since the efficiency of individual designs varies widely, a few being more efficient and many more being less efficient than the table indicates.

Gravity and inertial chambers can remove only coarse particles. They can extract only a minor portion of the sizes which constitute health hazards. They are useful as traps or, more rarely, as primary cleaners to relieve the load on filtering plants.

The common large-diameter cyclone is the least costly cleaning device. It is satisfactory for sawdust and shavings or for grinding, polishing and buffing dusts when so located that the dust-bearing discharged air is well diluted before reentering work spaces. The cyclone, also, is used for rough separation ahead of filters and other refined types of cleaner. Certain types of small-diameter or long-cone cyclones of higher cleaning efficiency are used singly, in pairs or in clusters where the cleanliness requirements justify the higher cost.

Cloth filters of either the bag or screen types are capable of reducing the outlet dust concentration to safe levels. They must be cleaned periodically by shaking or rapping while the air current is cut off. In order to reduce the cleaning frequency and to minimize fabric wear, some sort of primary separator or precleaner is installed ahead of the filter whenever the dust loading of the entering air is heavy. The gas temperature must be kept above the dewpoint, yet must not exceed about 180F for cotton cloth or 230F for wool. Combustible filter media present some fire hazard which can be minimized by the installation of sprinklers and the electrical grounding of fabric and casing.

Certain types of air washers employing centrifugal or inertial forces are capable of removing pathologically important dust particles to a safe concentration. Large, chamber-like washers containing a battery of spray nozzles are ineffective in the removal of industrial dusts. Likewise, cleaners in which dirty air is bubbled through a water bath are an utter waste of money. Scrubbers are applicable only when the dust is wettable by the sprayed fluid. The cost of water as well as the cost of dewatering sludge either for recovery of solids or to prevent clogged sewers must not be ignored. Winter freezing, also, may be troublesome.

Electrostatic precipitators have been successfully operated for many years in large sized units for the recovery of cement dust and smelter fume. Their cleaning efficiency can be very high. Heretofore they have been comparatively costly and each installation has been a highly individualized engineering problem. Recently, however, newer devices have been placed on the market in the form of somewhat standardized units. It remains to be seen to what extent the manufacturers have solved the problems of high initial cost, freedom from specialized maintenance and "tailor made" design and engineering.

Mechanics of Separation

One characteristic is common to all types of dust separator. Each particle must be acted upon by some force which does not act upon the entraining air or acts upon it in a different or lesser degree so that the particle will move from the conveying air stream to a region where the conveying forces are less effective or non-existent or counteracted by more powerful forces of retention. In all separators the particle must move through some distance laterally across the air stream. At its destination it must be entrapped in some manner so that it cannot again enter the cleaned air. In a set-

TABLE 15. APPROXIMATE SETTLING RATE OF SPHERES (SP. GR. 1.0) IN STILL AIR AT 70F.

Diameter, Microns	Rate of Fall	
	Ft. per Min.	In. per Hr.
5000	1750	—
1000	790	—
500	555	—
100	59.2	—
50	14.8	—
10	0.592	—
5	0.148	—
1	0.007	5
0.5	0.002	1.4
0.1	0.00007	0.05
Smaller	0	0
	(Brownian movement)	

tling chamber, the separating force is gravity. In a cyclone, it is the centrifugal force of rotation. Centrifugal or inertial scrubbers employ the same effect. Electrostatic charges constitute the separating agencies in electrical precipitators. Even filters employ highly localized centrifugal and inertial forces in the entrapment of particles.†

It is evident that for effective separation, the differential force acting upon the particle must be as great as possible and that the distance through which the particle moves must be a minimum. Since the particle must traverse the air stream laterally, the stream must be as narrow as possible or must be broken into a number of streams of small dimensions.

Size Properties and Settling Rates of Dusts

Particles smaller than 0.1 micron are commonly termed smokes. They are in active Brownian movement. Gravity separation is theoretically and practically impossible in this range. Larger particles, falling in still air, attain velocities at which the air resistance exactly balances the force of gravity. Known as the terminal velocity, this is the maximum speed of free fall which the particle can attain. Finely divided dusts reach their terminal velocities almost instantly. Table 15 gives the calculated settling rates of spherical particles in still air at 70F for material of specific gravity of 1.0. Since actual dust particles are far from spherical and since true still-air conditions do not exist in practice, the rate of fall as determined by experiment is not far from one-half the values in Table 15. Table 16 lists the approximate median size of a number of air-borne dusts. In order to compare the micron dimensions of particles with the more familiar standard screen mesh numbers, Table 17 is presented.

†While the mechanics of filtration is but imperfectly formulated, it is known that straining in the ordinary sense plays only a small part. The open mesh of filter cloth is many times larger than the particle which it entraps.

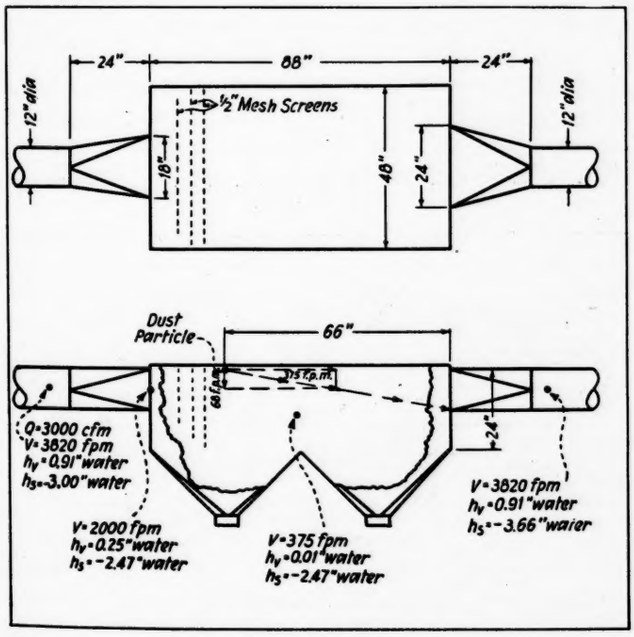


Fig. 60. Gravity trap.

TABLE 16. APPROXIMATE MEDIAN SIZE OF AIR-BORNE DUSTS‡

Kind of Dust	Median Size, Microns
Outdoor dust	0.5
Sand blasting	1.4
Granite cutting	1.4
Trap rock milling	
Crusher house	1.4
Screen house	1.3
Disc crusher	0.9
Foundry parting compound	1.4
General foundry air	1.2
Talc milling	1.5
Slate milling	1.7
Marble cutting	1.5
Soapstone	2.4
Aluminum dust	2.2
Bronze dust	1.5
Anthracite coal mining	
Breaker air	1.0
Mine air	0.9
Coal drilling	1.0
Coal loading	0.8
Rock drilling	1.0

‡The Determination and Control of Industrial Dust—Public Health Bulletin No. 217, U. S. Public Health Service, 1935.

Gravity Chambers

The principal field of gravity separators is the entrapment of stray work pieces lost in hand grinding or the separation of tramp metal, saw edgings, blocks or

TABLE 17. MICRON DIMENSIONS OF STANDARD SIEVES.

Sieve Designation*		Opening, In.	Sieve Designation*		Opening, In.	Microns	Approx. Sub Mesh
Microns	U. S. Std. Sieve No.		Microns	U. S. Std. Sieve No.			
4760	4	0.187	420	40	0.0165	35	450
4000	5	0.157	350	45	0.0138	30	500
3360	6	0.132	297	50	0.0117	20	625
2830	7	0.111	250	60	0.0098	10	1250
2380	8	0.0937	210	70	0.0083	5	2500
2000	10	0.0787	177	80	0.0070	2	6250
1680	12	0.0661	149	100	0.0059	1	12500
1410	14	0.0555	125	120	0.0049	—	—
1190	16	0.0469	105	140	0.0041	—	—
1000	18	0.0394	88	170	0.0035	—	—
840	20	0.0331	74	200	0.0029	—	—
710	25	0.0280	62	230	0.0024	—	—
590	30	0.0232	53	270	0.0021	—	—
500	35	0.0197	44	325	0.0017	—	—

*ASTM Standard Specifications for Sieves for Testing Purposes, E 11-26.

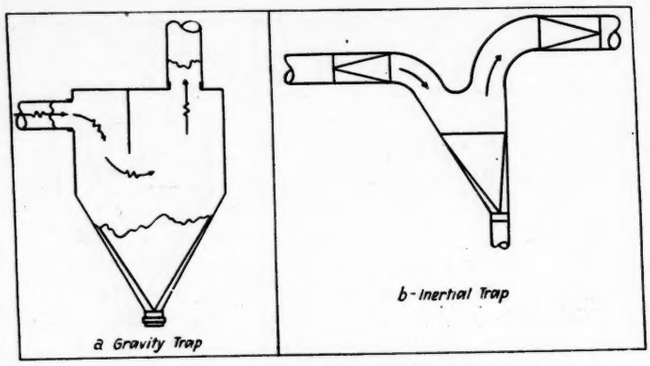
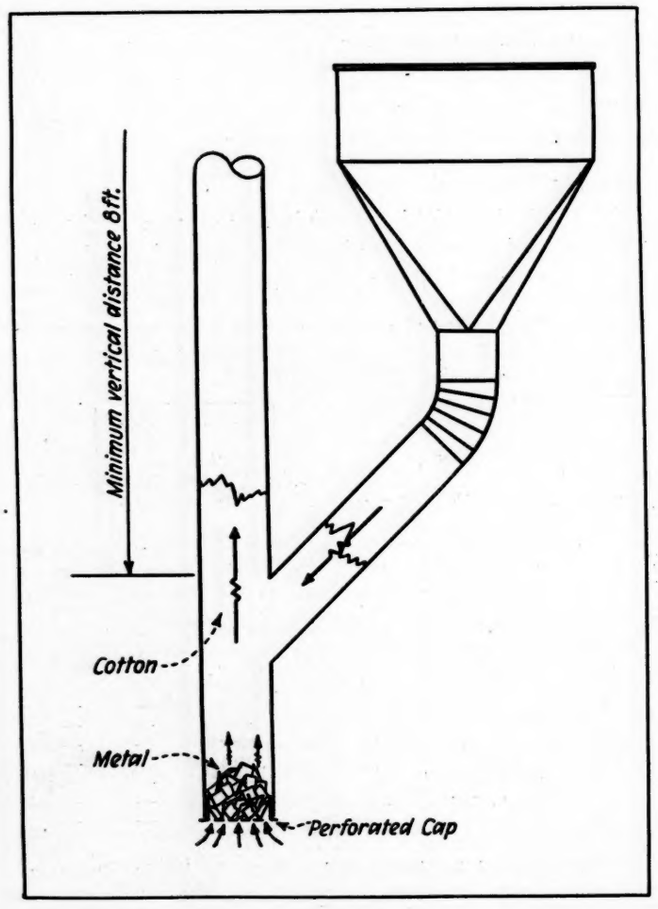


Fig. 61. Gravity and inertial separators

other large or heavy materials which should not enter the fan or secondary cleaner. They are excessively large and costly unless their application is limited to particles larger than 100 to 200 micons. Even as primary cleaners they are seldom as effective or cheap as the ordinary cyclone.

A simple gravity trap is shown with its dimensions and pertinent flow data in Fig. 60. A dust particle is shown suspended near the top of the air stream at a location downstream of the diffusing screens at which the air speed is reasonably uniform across the section. To be entrapped, it must fall at least to the lower level of the outlet pipe. Hence, knowing the suspending air velocity, we can determine vectorially that the minimum settling velocity must be 68 f.p.m. to insure entrapment. A spherical quartz particle (sp. gr. 2.65) of about 80 microns will have this rate of fall in perfectly still air. Because of turbulence and the non-sphericity of the particle, the minimum particle size for which the trap is effective is more nearly 160 microns.



Settling Chamber Velocities

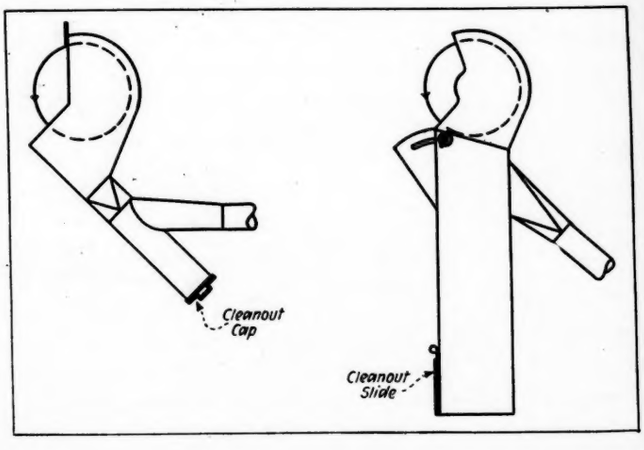
While the velocities in gravity chambers recommended by various authors range from 4 to 120 f.p.m., cost and available space seldom permit air speeds less than 300 f.p.m. Even this value may become impracticable because of chamber size. For example, if the conveying velocity is 4500 f.p.m., the chamber cross-sectional area must be made at least 15 times the pipe area to reduce the average air speed to 300 f.p.m.

Resistance of Chambers

Frictional resistance plays but a negligible part in the pressure loss of a gravity chamber. The essential operating principle of the chamber requires that the conveying velocity be dissipated in order to promote dust settlement. The conveying velocity must be restored at the trap outlet at the cost of static pressure in the same way that static suction is expended in causing air to enter a hood. The pressure loss of the chamber, therefore, is the pressure required to accelerate the air at the outlet less whatever conversion of velocity pressure to static pressure takes place at the inlet. Thus, in Fig. 60, the trap outlet may be treated as a suction hood whose entry coefficient is 0.85, drawing air from the trap body. To set up the conveying velocity in the outlet pipe causes an expenditure of 1.32 velocity heads to which must be credited the trap velocity pressure of 0.01 in. of water. The net increase in suction needed for producing flow in the outlet is 1.19 in. of water. The static pressure regain in the inlet transformer is calculated to be 0.53 in. of water, using the expansion loss data of Fig. 54. The pressure loss through the trap then becomes 1.19 — 0.53 or 0.66 in. of water.

Many trap designs omit the tapered inlet and outlet connections, thereby losing the benefit of the static pressure regain and the more favorable entry coefficient at the outlet. Had the transformers been omitted from the trap in Fig. 60, the pressure loss would have been 1.35 in. of water or more than double that of the design shown. The resistance of gravity chambers as usually constructed will range from 1.5 to 2.0 velocity

Fig. 62 (Left). Tramp iron trap. Fig. 63 (Below). Hood traps.



heads. Superior design can reduce the loss to not more than 0.75 velocity heads. These losses are expressed in terms of the velocity head present in the outlet pipe.

Miscellaneous Traps

All traps in which a change of direction of flow takes place utilize inertia or centrifugal force in some degree. Thus, while the trap in Fig. 61a is essentially a gravity trap, some inertial separation takes place. Likewise, some gravity separation occurs in the inertial trap in Fig. 61b. Fig. 62 illustrates an effective trap for the removal of stray metal from cotton. Were the bottom of the vertical pipe to be blanked off by a solid cap, the pipe would soon fill with matted cotton. Enough air is admitted through the perforations to float the cotton but not the metal. The difference in specific gravity of metal and cotton is so great that the area of the secondary air inlet is not critical. However, sufficient air must be admitted through the perforations to maintain adequate conveying velocity in the vertical pipe even though the air supply through the hopper is cut off by excessive quantities of cotton. Traps in buffing and grinding hoods such as Fig. 63 will catch small work pieces twisted out of the operator's grasp. These pieces are often salvageable and, in any event, should be kept out of the fan and separator.

Cross-Connections in Air Conditioning Equipment

INSTALLATION of air conditioning equipment has in many instances created many actual and potential cross-connection hazards which endanger the purity of the water supply, according to F. M. Dawson and A. A. Kalinske of the State University of Iowa in a recent bulletin issued by the National Association of Master Plumbers of the United States. The following has been abstracted from its bulletin:

The main use of water in air conditioning apparatus is for condensing the refrigerant used in the cooling arrangement. In many instances, a direct solid (i.e., not open) connection is made from the public water supply to the condenser.

The factor which determines whether any such direct connection is to be permitted at all is the toxicity of the refrigerant. It is the writers' opinion that no direct connection between the public water supply and a condenser having a toxic refrigerant should be permitted. Refrigerants such as ammonia, methyl chloride, sulphur dioxide, dichlorethylene, propane, and probably others must be considered as toxic under certain conditions. Direct connections even to non-toxic refrigerant condensers are not highly desirable for several reasons, one being the possibility of a connection being put in between the condenser waste and a sewer. However, these direct connections under certain ideal conditions might be permitted, although they must be regarded as a potentially weak point in the system.

Frequently the waste water from a condenser is run directly to a sewer or drain through a solid connection. If the condenser is directly connected to the water supply, there then exists a direct connection between the water pipes and the sewers. This is probably the worst type of cross-connection in air conditioning equipment.

In two types of air conditioning apparatus, open collecting pans or tanks are used. The water in these pans or tanks has to be considered impure even when it appears to be safe. This is particularly true when the condenser cooling water is re-used by cooling it after it leaves the condensers by means of ponds, sprays or towers. Since the cooling of this water is accomplished primarily by evaporation, the supply must be replenished, which fact necessitates a water connection to the cooling pond or collecting pan at the bottom of the cooling tower. The water inlet to such ponds or pans must be above the maximum possible water level.

To eliminate practically all water pollution hazards usually found in the connection of such equipment the observance of a few fundamental principles are recommended. Briefly stated they are:

(1) Direct water connections to condensers or gas compressors for cooling purposes should not be made if toxic refrigerants or gases are handled, and preferably no direct connections for any refrigerant. The connection should be broken by allowing city water to enter a gravity feed tank or pump surge tank above the maximum water level. The surge tank with pump located near the point of water use is desirable.

(2) The waste from a condenser or compressor should never be directly connected to any part of the drainage system. A clear air gap of about four inches should exist. Overflows from gravity feed tanks, surge tanks, or various collecting pans should not be directly connected to the drainage system.

(3) Water supply inlets to collecting pans in air washers, to dehumidifiers and to cooling ponds or towers must be above the maximum possible water level.

(4) No direct cross-connection, or provision therefore, should be allowed between the city water and an auxiliary supply from a private source unless such auxiliary supply has a sanitary quality equal to or better than the city water, and then only when no cross-connections or submerged inlets of whatever sort exist on the piping system using the auxiliary supply.

(5) Re-use of condensing and cooling water in the domestic supply system is not desirable and should be prohibited if such water comes from condensers or compressors handling toxic materials.

EDITORIALS

Group Heating

The fifty-odd groups of apartment houses erected with government money during recent years are now all, or nearly all, in operation. To some, doubtless their chief interest is social and political but to heating men they are of interest chiefly as group heating projects. It is believed that these fifty building groups contain the best heating plants ever developed and installed for group heating. As such they are likely to set the style and to influence the thinking for a long time. It is for this reason that their principal features have been described in HEATING & VENTILATING from time to time. It is appropriate that descriptions of two more of them are included in this issue. One is the largest of all such projects and uses a series of fairly small generating plants while the other uses a central generating plant. Now that more of these group housing projects are to go forward with government money while similar privately financed groups are being announced, interest in this subject of group heating will continue for some time and will provide a market for equipment and a field for engineers and contractors.

While the broad lines have been pretty well fixed in the government groups this does not mean that there is no room for further ingenuity. If as much inventiveness and thoughtful planning can continue to go into group heating projects as has been given to them in the past few years, the 1945 plant may no more resemble the 1938 installation in detail than the 1938 plant is like the apartment house installation of 1930. Then, apartment work was strictly chiseling work, cheaply done and slipshod in nearly every respect. Now the background is at hand to completely change all this.

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Steam Service for Industry

Steam service to industry adequate to meet all process and heating requirements is one of the possibilities of central station generation which has attracted the attention of both utility and industrial managements. Steam and electric power are so closely related and both are required by industry so generally that there is no end to the possible arrangements which may be made to secure them. The utility central station electric companies would like to furnish the electric service but are apparently undecided as to the desirability of also undertaking to furnish the steam service. The possibilities have been studied and analyzed repeatedly in various localities but the most notable existing utility installations are those in Rochester and Indianapolis. In these two cities there are steam plants erected especially with an eye to supplying adjacent industrial areas. Elsewhere in this issue is a running account of what has been accomplished in recent years in building up a load on these generating plants in Indianapolis. During a depressed period the yearly send-out of steam has doubled. Here is an object lesson to show that load *can* be secured by being prepared to offer a service for which there is a market. It seems certain that as time goes on the importance of these Rochester and Indianapolis practices will be better understood. It is also noteworthy that the utility companies have no monopoly on taking advantage of the possibilities of furnishing a steam service to industry. Generating plants owned and operated by industry itself can also furnish a steam service to neighboring plants. Here and there this is being done now and here and there too the possibilities are being examined by industry as well as by utilities. The utilities would seem to have the most to gain by going wholeheartedly into furnishing all the needs of industry but the actual moves along this line have been painfully slow in spite of the object lessons at hand.

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Off-Peak Cooling

Of late there has been a stirring of interest in connection with means for reducing the electric power demand of summer cooling equipment. It seems that in some localities so much electrically-driven summer air-cooling equipment has been installed that it is adding to the system peak load. This means that the air cooling equipment is eligible to be charged at the on-peak rate and also that the electric utility companies in these localities are not especially enthusiastic about encouraging any additional air cooling installations on their systems.

Two principal methods of relieving this situation are generally considered suitable. One is to use a cold-storing method which will permit the cooling equipment to store up cooling capacity during off-peak hours and draw only a minimum of current during the electric system peak. The other also uses the storage idea but is so designed as to operate steadily during a peak day. Of the methods of storing up cold which are available that of cooling a tank of water, or of eventually freezing this water into ice, is the one which is drawing attention. This is essentially a revival of the congealing tank or hold-over tank which has long been a familiar device in refrigeration and cold-storage practice. Like the evaporative condenser which was also originally found in cold-storage and ice-making plants, this idea of the hold-over tank is a means of meeting a peculiar set of conditions. It is not to be expected though that the new application of this old principle will consist simply of a revival. Instead the whole process is being studied intensively and even now some new and novel equipment for accomplishing the process is being announced and tried out. Just as the new, present-day evaporative condenser is a greatly improved product so is the new hold-over tank equipment expected to excel the old. We need no better example of how well the air cooling industry is equipped with technical design skill than that afforded when the water shortage problem brought forth the improved condenser. Now the process is being repeated with the hold-over tank.

ABSTRACTS of Current Papers, Books and Pamphlets

Gas Heating Handbook

Upon the salesmen selling heating equipment rests in many cases the responsibility for the proper estimation, selection and design of many heating and air conditioning systems. That the gas industry has recognized this fact is shown by this book on comfort heating, written expressly for the gas heating salesman.

The purpose of the book is to make available the technical information needed by these salesmen in a form ready for use and simple to apply. In order to do this it was necessary to omit certain technical details which may result in the elimination of certain refinements in practice, but the committee which prepared this book felt that this was justified in view of the purpose.

A good illustration of the way in which the material has been simplified is given by the heat transmission coefficient tables. These tables list the coefficients with fewer decimal points than is usual and all coefficients not different from each other by 2% have been grouped together. It is felt that the inaccuracies which are introduced by this are less than the general errors involved in house heating loss determination.

Particularly important to the salesman are the tables which are designed to make it possible to select the proper type of equipment for most installations without any computations. Another feature of the book is the inclusion of the capacity of convectors of various manufacturers designed for ready references.

In actual physical appearance the book is unusual. It is designed to be used as is or else by the removal of a plastic binding to be inserted in any standard three-ring binder such as is ordinarily used by a salesman. The book is printed on paper which is unusually strong and tough and will take writing without spreading ink.

[*"Comfort Heating." Published by the American Gas Association, 420 Lexington Ave., New York. Cloth cover; 8½ x 11 in., 81 pages; price, $2.*]

●

Thermal Radiation from Concrete Surfaces

The thermal conditions of a room, in so far as they influence the sensation of comfort of the occupants, depend upon the temperature, humidity, and motion of the air within the room, and upon the temperature and emissivity of the surfaces of the enclosing walls, floor, and ceiling.

In order to design and operate the air conditioning equipment for a room so as to secure satisfactory thermal conditions, it is important to know the temperatures and the emissivities of the surface finishes which are applied to the walls, floor, and ceiling of the room.

The purpose of this investigation was to determine the emissivities of bare concrete and of the surface finishes which are commonly applied to concrete in building construction: alabaster, acme cement plaster, lime plaster, white lead paint, and aluminum paint.

The emissivity of a body is the ratio of the rate at which its surface radiates energy to the rate at which a black body, i.e., a perfect radiator, at the same temperature, radiates energy. A black body is one which absorbs all radiant energy incident upon it.

At a temperature of 68F, Coblentz's formula indicates that a black body will radiate 133 B.t.u. per hr. per sq. ft. Hence, if the wall of a room, at a temperature of 68F, radiates 80 B.t.u. per hr. per sq. ft., the surface of that wall has an emissivity of 0.60.

The coefficients of emission found for the various concrete surfaces are given in the table. They are not to be taken as accurate absolute values, but only as approximations. To obtain accurate values the apparatus and perhaps even the method of testing would have to be refined considerably. These values, however, are sufficiently accurate for all comparative purposes.

COEFFICIENTS OF EMISSION

Material	Emissivity
Black body (theoretical)	1.00
Bare concrete	0.83
Alabastine	0.79
Acme cement plaster	0.79
Lime and sand plaster	0.85
Paint (white lead)	0.77
Paint (aluminum)	0.36

[*"A Study of Thermal Radiation," by James R. D. Eddy and James H. Nelson. Published by Texas Engineering Experiment Station of the Agricultural and Mechanical College of Texas, College Station, Texas. Bulletin No. 29. Paper cover; 6 x 9 in.; 24 pages.*]

●

Design and Shop Practice

Some time ago the power section of Kent's Mechanical Engineers' Handbook appeared as a separate book. Now the design and shop practice section has appeared, completing the 11th edition. The division of the handbook into two volumes has permitted a more thorough treatment of the material in the earlier editions and the inclusion of many new subjects.

Since the development in the past ten years of many new materials of engineering and the improvement in tools, machinery and processes have made many of the data in the earlier editions obsolete, the book has been practically rewritten.

This volume is divided into 28 sections. Some of the sections of interest to heating and air conditioning engineers include the following: general properties of materials; strength of materials; bearings and lubricants; gearing; control mechanisms; vibration and noise; structures and buildings; industrial heating processes; the machine shop; materials handling; power transmission; electric motors and their control; safety engineering; and mathematical tables.

[*"Kent's Mechanical Engineers' Handbook—Design and Shop Practice," 11th edition, edited by Robert T. Kent. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York. Flexible cover; 5½ x 8½ in.; 1378 pages; price, $5.*]

Identification of Atmospheric Dust Particles

In estimating the hazardous qualities of a dusty atmosphere it is frequently desirable to determine the composition of the air-borne dust. Samples collected from the air may be analyzed chemically, by X-ray diffraction, or by the petrographic microscope. Chemical methods are unsatisfactory owing to the small samples usually available and to the limitations and complexities of present methods. X-ray technique requires expensive apparatus not ordinarily available except in research laboratories.

Owing to the simplicity and rapidity of petrographic examination of atmospheric mineral dust, it was considered worthy of further study. Petrographic identification of minerals is based on the measurement and observation of optical properties. The fundamental optical properties usually measured are: (a) the values of the indices of refraction of the one, two, or three different light rays passing through the crystal; (b) the orientation of the vibration directions of these rays with respect to the crystal; (c) the amount of adsorption of light for the different rays; and (d) the variations of these optical properties with the wave length of the light used for measuring.

This report briefly reviews the use and limitations of the petrographic microscope and the method in use at present by the Health Division of the Bureau of Mines for ascertaining maximum quartz (free silica) content by this means.

[*"Petrographic Identification of Atmospheric Dust Particles," by W. D. Foster and H. H. Schrenk. Report of Investigations 3368, United States Bureau of Mines. Paper cover; 8½ x 11 in.; mimeographed; 10 pages. Available from the Bureau of Mines, Washington, D. C.*]

BRIEF REVIEWS

DUST. Purpose of this paper is to point out those dust sources commonly encountered in foundry operations and to discuss methods and procedures of eliminating or controlling the dust generated or released at these points. No consideration is given to the pathological effects of the dust productions described. [*"The Application of Dust Control Principles to Foundry Operations," by Ralph R. Meigs. Paper presented before the Second New England Regional Foundry Conference held at Massachusetts Institute of Technology, Boston, Mass., April 8 and 9, 1938. Paper cover; 22 pages; 6 x 9 in.*]

ANTHRACITE. A reprint of papers presented at the first annual anthracite conference of Lehigh University, April 29-30, 1938, Bethlehem, Pa. Booklet consists of 18 papers divided into five classifications. These classifications are: inherent characteristics of anthracite; the combustion characteristics of anthracite; a description of the combustion and operation of anthracite burning equipment; some aspects of the commercial application of anthracite; and the merchandising and civic values of anthracite. [*"Transactions of the First Annual Anthracite Conference of Lehigh University." Paper cover; 6 x 9 in.; 187 pages; price, $1. Copies can be obtained from Anthracite Industries Laboratory, Primos, Pa.*

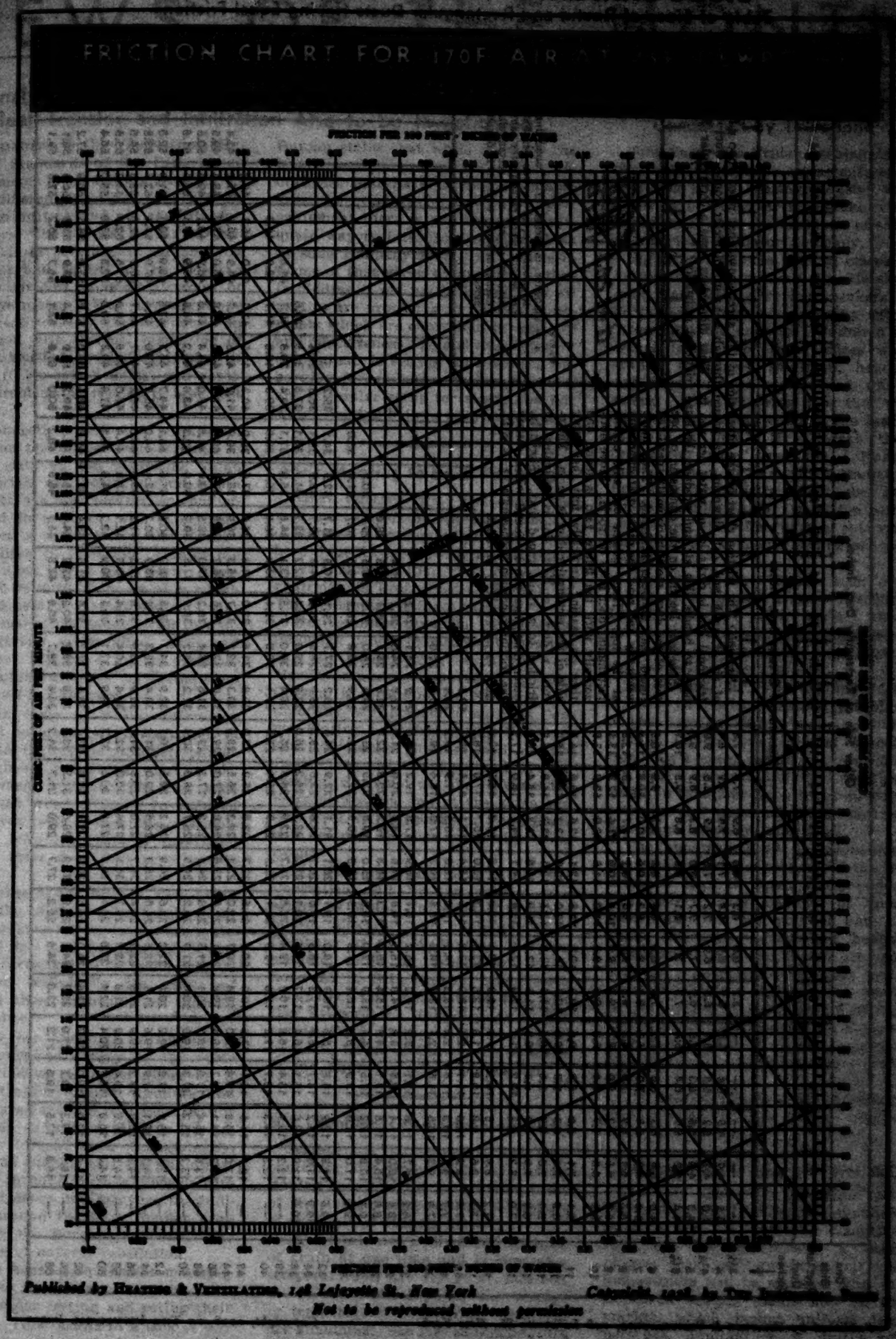
ANTHRACITE. Statistics on anthracite wholesaling for the year 1935 which were collected by a field canvass of wholesale establishments in the United States by the Bureau of Census. The investigation was based on wholesale establishments which sell primarily to retailers, institutes, industrial users and other wholesale organizations for resale or further processing or business use. No establishments were included in this report unless 50% or more of their sales were made at wholesale. Gives data on employment, payrolls, distribution of sales, credit sales, and analysis of sales by commodities. [*"Anthracite Wholesaling: 1935," prepared by Albert Haring, Bureau of Census, United States Department of Commerce. Paper cover; 13 pages; 8½ x 11 in.; mimeographed; obtainable from Bureau of Census, Washington, D. C.*]

PLUMBING CROSS-CONNECTIONS. A report on research conducted on back-siphonage and plumbing cross-connection at the University of Iowa. Report is divided into 10 sections, each summarizing one particular part of the problem. The section on cross-connections in air conditioning equipment will be of principal interest to heating and air conditioning engineers. Abstracts from this section appear on page 61 of this issue. [*"Report on Plumbing Cross-Connections and Back-Siphonage Research," by F. M. Dawson and A. A. Kalinske. Technical Bulletin No. 1. National Association of Master Plumbers of the United States, Inc., Washington, D. C. Paper cover; 79 pages; 5½ x 8½ in.*]

OIL TREATMENT OF COAL. A progress report on a comprehensive investigation of the factors involved in the treatment of coal with petroleum products. The major portion of this investigation has been concerned with the treatment of coal in the laboratory with different oils in varying amounts and the determination of the reduction in dustiness after various periods of exposure to the weather. Data are presented for five different oils, one for petrolatum, and on coal from two typical seams. Data are also given showing the effect of oil treatment on segregation of coal in small stokers. [*"An Experimental Investigation of the Use of Oil for the Treatment of Coal," by R. A. Sherman and J. M. Pilcher. Paper presented at the annual meeting of the ASME, December 10, 1937 and appearing in the February, 1938 ASME Transactions. 13 pages.*]

POWER. Proceedings of the Midwest Power Conference held in Chicago on April 13-15, 1938. The purpose of this conference was to offer an opportunity for all persons interested in power protection, transmission or consumption to meet together for a study of mutual problems free from the restrictions of required memberships in technical or social organizations. Papers of interest to heating and air conditioning engineers include: Advances in the solution of Fuel Problems; Heat Energy Costs of B.t.u. Auditing; and Power Requirements for Residential Air Conditioning. [*"Proceedings of the Midwest Power Conference Sponsored by Armour Institute of Technology." Published by Armour Institute of Technology, Chicago. Paper cover; 170 pages; 6 x 9 in.; price, $2.*]

ESTIMATING FRICTION OF VENTILATING DUCTS


FRICTION CHART FOR 170F AIR AT
FRICTION PER 100 FEET - INCHES OF WATER
CUBIC FEET OF AIR PER MINUTE
FRICTION PER 100 FEET - INCHES OF WATER
Published by HEATING & VENTILATING, 148 Lafayette St., New York
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H. & V.'s REFERENCE DATA—127

ESTIMATING FRICTION OF VENTILATING DUCTS

Table of Sizes of Round and Rectangular Ducts Having Equal Friction

$$d = 1.265 \sqrt{\frac{Q^{1.85}}{Vdf^5}}$$

where

d = diameter, in inches, of a round duct of equal friction per foot,

Q = quantity of air in a rectangular duct, in cubic ft. per min.,

V = velocity of air in a rectangular duct, in inches by 1 inches in diameter,

f = coefficient of friction.

Example. The friction chart on the other side of this sheet shows that when 1000 cu. ft. of air per min. are passed through a 12-in. diameter round duct the frictional loss is 0.08 in. per 100 ft. What dimensions must a rectangular duct have to handle this air and produce the same frictional resistance?

Solution: Decide on the dimensions of one side of the rectangular duct, then find the other side as follows: Suppose the width is to be 10 in., and the duct is to be used vertically with the long side vertical. Then in the column headed "Diameter of Circular Duct, Inches" find the size of round duct which will carry 1000 cu. ft. of air per min. with a friction of 0.08 in. per 100 ft. This is found to be 12.9 in. Now look in the column headed "Other Side of Rectangular Duct, Inches" for the size which is opposite 10 in. in the column headed "Side of Rectangular Duct Which Is Given." This is found to be 15 in. Therefore, a duct 10 × 15 in. is equivalent in friction to a 12.9-in. round duct. Similarly, other duct sizes can be found which satisfy the friction condition, including a 15 × 8 in. duct or an 18 × 7 in. duct.

Side of Rectangular Duct, Inches Which Is Given	Other Side of Rectangular Duct, Inches	Diameter of Circular Duct, Inches
4	4	4.0
	5	4.4
	6	4.8
	7	5.1
	8	5.4
	9	5.7
	10	6.0
	11	6.2
	12	6.5
	14	6.9
	16	7.4
	18	7.8
	20	8.2
	22	8.5
	24	8.8
	26	9.1
	28	9.4
	30	9.7
	32	10.0
	34	10.2
	36	10.5
	38	10.7
	40	11.0
	42	11.2
	44	11.4
	46	11.6
	48	11.8
5	5	5.0
	6	5.4
	7	5.8
	8	6.1
	9	6.4
	10	6.7
	11	7.0
	12	7.2
	14	7.7
	16	8.2
	18	8.6
	20	9.0
	22	9.4
	24	9.7
	26	10.0
	28	10.3
	30	10.6
	32	10.9
	34	11.2
	36	11.4
	38	11.7
	40	11.9
	42	12.2
	44	12.4
	46	12.6
	48	12.8
6	6	6.0
	7	6.4
	8	6.8
	9	7.1
	10	7.4
	11	7.7
	12	8.0
	14	8.5
	16	9.0
	18	9.5
	20	9.9
	22	10.3
	24	10.7
	26	11.0
	28	11.3
	30	11.6
	32	11.9
	34	12.2
	36	12.5
	38	12.8
	40	13.0
	42	13.3
	44	13.5
	46	13.7
	48	13.9
7	7	7.0
	8	7.4
	9	7.8
	10	8.1
	11	8.4
	12	8.7
	14	9.3
	16	9.8
	18	10.3
	20	10.8
	22	11.2
	24	11.6
	26	12.0
	28	12.3
	30	12.6
	32	12.9
	34	13.2
	36	13.5
	38	13.8
	40	14.1
	42	14.4
	44	14.6
	46	14.8
	48	15.0
8	8	8.0
	9	8.4
	10	8.8
	11	9.1
	12	9.4
	14	10.0
	16	10.6
	18	11.1
	20	11.6
	22	12.1
	24	12.5
	26	12.9
	28	13.3
	30	13.6
	32	13.9
	34	14.2
	36	14.5
	38	14.8
	40	15.1
	42	15.4
	44	15.7
	46	15.9
	48	16.1
9	9	9.0
	10	9.4
	11	9.7
	12	10.0
	14	10.7
	16	11.3
	18	11.8
	20	12.3
	22	12.8
	24	13.3
	26	13.7
	28	14.1
	30	14.5
	32	14.8
	34	15.1
	36	15.4
	38	15.7
	40	16.0
	42	16.3
	44	16.6
	46	16.9
	48	17.1
10	10	10.0
	11	10.3
	12	10.6
	14	11.3
	16	11.9
	18	12.5
	20	13.0
	22	13.5
	24	14.0
	26	14.4
	28	14.8
	30	15.2
	32	15.6
	34	15.9
	36	16.2
	38	16.5
	40	16.8
	42	17.1
	44	17.4
	46	17.7
	48	17.9
11	11	11.0
	12	11.3
	14	12.0
	16	12.6
	18	13.2
	20	13.7
	22	14.2
	24	14.7
	26	15.1
	28	15.5
	30	15.9
	32	16.3
	34	16.6
	36	16.9
	38	17.2
	40	17.5
	42	17.8
	44	18.1
	46	18.4
	48	18.6
12	12	12.0
	14	12.7
	16	13.3
	18	13.9
	20	14.4
	22	14.9
	24	15.4
	26	15.8
	28	16.2
	30	16.6
	32	17.0
	34	17.3
	36	17.6
	38	17.9
	40	18.2
	42	18.5
	44	18.8
	46	19.1
	48	19.3
13	13	13.0
	14	13.4
	16	14.0
	18	14.6
	20	15.1
	22	15.6
	24	16.1
	26	16.5
	28	16.9
	30	17.3
	32	17.7
	34	18.0
	36	18.3
	38	18.6
	40	18.9
	42	19.2
	44	19.5
	46	19.8
	48	20.0
14	14	14.0
	16	14.6
	18	15.2
	20	15.7
	22	16.2
	24	16.7
	26	17.1
	28	17.5
	30	17.9
	32	18.3
	34	18.6
	36	18.9
	38	19.2
	40	19.5
	42	19.8
	44	20.1
	46	20.4
	48	20.6
15	15	15.0
	16	15.2
	18	15.8
	20	16.3
	22	16.8
	24	17.3
	26	17.7
	28	18.1
	30	18.5
	32	18.9
	34	19.2
	36	19.5
	38	19.8
	40	20.1
	42	20.4
	44	20.7
	46	21.0
	48	21.2
16	16	16.0
	18	16.4
	20	16.9
	22	17.4
	24	17.9
	26	18.3
	28	18.7
	30	19.1
	32	19.5
	34	19.8
	36	20.1
	38	20.4
	40	20.7
	42	21.0
	44	21.3
	46	21.6
	48	21.8
17	17	17.0
	18	17.0
	20	17.5
	22	18.0
	24	18.5
	26	18.9
	28	19.3
	30	19.7
	32	20.1
	34	20.4
	36	20.7
	38	21.0
	40	21.3
	42	21.6
	44	21.9
	46	22.2
	48	22.4
18	18	18.0
	20	18.1
	22	18.6
	24	19.1
	26	19.5
	28	19.9
	30	20.3
	32	20.7
	34	21.0
	36	21.3
	38	21.6
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	44	22.5
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	48	46.1
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	46	46.9
	48	47.1
45	45	45.0
	46	47.9
	48	48.1
46	46	46.0
	48	49.1
47	47	47.0
	48	50.1
48	48	48.0

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NEWS OF THE MONTH

National Bureau of Standards to Study Ratings of Equipment; Heat Transfer and Infiltration Also to be Investigated

WASHINGTON, D. C.—The National Bureau of Standards of the Department of Commerce is conducting research on three different subjects of great interest to heating and air conditioning engineers. The purpose of the investigations is to obtain data on building materials and equipment in order to aid the low-cost housing program of the government. The investigations cover heat transfer measurements in connection with thermal insulation of low-cost housing, heating equipment as related to low-cost housing, and ventilation problems as related to low- cost housing.

In connection with the studies on insulation the Bureau will attempt to provide data on the insulating value of materials and constructions where such data are now lacking or conflicting, and in addition will investigate the effect of moisture on the insulating qualities of materials. One of the studies along these lines is to determine the validity of the opinion which has been held in various quarters that the thermal conductance of fill insulating materials in so-called "full wall thickness" (3½ to 4 in.) is considerably less than would be calculated from tests on a 1-in. thickness.

Certain types of wall construction have not been entirely investigated in regard to their heat transfer, particularly those containing steel studs. Measurement will be made of a number of such types of walls. In addition the Bureau will review the available data on reflective types of insulation and put these data into more usable form.

According to the Bureau, data available on the effect of hygroscopic water on the conductivity of insulating materials are few and conflicting. A systematic investigation is under way to determine technically the effect of water in these materials on thermal conductance.

In low-cost housing, ventilation is usually supplied simply by the opening of windows or doors. However, if the infiltration around windows and doors is greater than that required for ventilation in winter there is an unnecessary loss of heat. Consequently, the Bureau intends to study the direct heat loss through various types of windows and doors and measure the infiltration around them. A further project which the Bureau may undertake is a study of natural ventilation.

Not all heating equipment manufacturers, the Bureau says, use the same equipment for testing and rating their products. This results in a lack of uniformity in test methods for heating boilers, radiators and convectors. The Bureau states that while many of the large manufacturers maintain laboratories and have established standards for the performance of their equipment there is not always an adequate way to interpret the data given by some company about its products in terms of that given by another so that in bidding it can not be known that all parties are proposing to furnish equipments which are equivalent in capacity and effectiveness. To end this difficulty the Bureau is setting up a testing apparatus for radiators and convectors, and a similar setup for steam and hot water heating boilers is in prospect.

ASRE Meeting to be at Penn. State

STATE COLLEGE, PA.—The 25th summer meeting of the American Society of Refrigeration Engineers will be held here June 19 to 21 with headquarters at The Nittany Lion. The convention chairman is Prof. Fred C. Stewart of The Pennsylvania State College.

The technical program includes the following papers of interest to heating and air conditioning engineers: on Monday morning, June 20, E. W. McGovern, E. I. duPont de Nemours and Company, will present a paper on Copper Plating in Refrigerating Compressors. Professor Stewart will discuss Basic Thermal Concepts and Refrigerating Systems at the Wednesday morning session and at the same session Prof. N. R. Sparks of Penn State will describe Estimating Refrigerating Loads.

Air Properties and How They Are Controlled will be the subject presented by Milton Kalischer of Westinghouse Electric and Manufacturing Company at the Wednesday morning session, while on Wednesday afternoon A. B. Schellenberg, Alco Valve Company, will demonstrate the Alco Gas Evaporator. Humidity As a Factor in Food Storage will be covered by L. L. Lewis of Carrier Corporation at the Thursday afternoon session.

A.C. Simulates Sun Heat on Seed

SPRINGFIELD, ILL.—Actual sun temperatures are produced by air conditioning today in the germinator trays of the indoor seed testing laboratory of the state of Illinois here.

The germinator holds 30,000 samples of grain at one time and is kept at a temperature of 68F for 14 hr. and 86F for 10 hr. of the day. By this change in temperature, actual soil conditions are simulated. The rise in temperature represents the sun's heat effect on the seed in the ground.

American Radiator Sales Meeting Conducted by Telephone

NEW YORK—On Friday evening April 29, the first telephone sales conference ever held in the heating industry was called to order by A. R. Herske, vice-president and general manager of sales of American Radiator Company.

Speaking from the general offices of American Radiator here, Mr. Herske's voice was heard over loudspeakers in 20 branch offices in as many cities throughout the country. Gathered together in each of these offices were branch managers, salesmen, heating and plumbing contractors and wholesalers. After declaring that this was "The end of an old era and the beginning of a new," Mr. Herske then turned the "wire" over to R. J. Hamilton, president of American Radiator. Speaking principally about the new building situation, Mr. Hamilton pointed out that since February of this year the building curve has swung sharply upward.

Once again Mr. Herske took over the meeting and discussed American Radiator's new price sheet, which establishes standard, unvariable prices for every product in the line, regardless of geographical location.

In closing, Mr. Herske introduced H. Mervyn Porter, national president of the Heating, Piping and Air Conditioning Contractors National Association. In a short extemporaneous talk Mr. Porter congratulated the American Radiator Company upon its progressive attitude and upon the modernization campaign recently launched.

The opportunity to get modernization sales was the keynote of the address by Max D. Rose, vice-president and eastern sales manager of American Radiator. He pointed out, "If every salesman, jobber and heating contractor would realize and act upon the vast possibilities of heating equipment for existing buildings we would not be reliant on the vagaries of new building but could develop an industry that could be more stable than new building, less competitive, more profitable."

The response to this first telephone sales conference will decide whether others are to follow.

Condemn Loose Use of Term A.C.

TORONTO, ONT.—The Canadian Institute of Plumbing & Heating announced recently that the term "air conditioning" has become largely a catch phrase. The Institute states that wise homeowners will be satisfied with the improved heating plants now on the market, which insure uniform temperature, elimination of drafts and cold spots, and the highly important factor of fuel economy.

District Heating Engineers to Convene in Baltimore June 28; Papers Scheduled on Corrosion, Steam Jets, Trouble Jobs

BALTIMORE—The tentative program for the 29th annual Convention of the National District Heating Association will provide an interesting and pleasant affair for the utility engineers who will attend. Headquarters will be at the Lord Baltimore Hotel here, June 28-July 1.

J. Earl Seiter, chairman of the convention committee, reports a full entertainment program in addition to a meaty technical program. The technical program follows:

JUNE 28—MORNING

Welcome address.
Response, First Vice-President J. R. McCausland.
President's Address—President T. E. Purcell.
Report of Educational Committee—L. S. Smith.
Report of Membership Committee—R. M. Nee.
Report of Secretary-Treasurer—W. H. Sanford.

AFTERNOON

Report of Operating Statistics Committee—A. D. Leach.
Report of Distribution Committee—W. A. Herr.

EVENING

Report of Steam Station Engineering Committee—A. R. Mumford.
Report of Nominating Committee.
Report of Advisory Council.
Report of Manufacturers' Committee.
Visit to the Manufacturers' Exhibits.

JUNE 29—MORNING

Report of Commercial Relations Committee—L. S. Phillips.
Control Systems—V. B. Ingram.
Methods of Utilization Work—W. C. Kaber.
Detection and Correction of Customer's Heating Troubles—J. F. Collins, Jr.
Report of Sales Development Committee—R. D. Martin.

JUNE 30—MORNING

Meters and Accessories Committee—W. W. Stevenson.
Report of Research Committee—G. K. Saurwein.
1. Corrosion of Steel Stacks—A. S. Griswold.
2. Steam Jet Refrigeration—H. W. Dierman.
3. Deterioration of Distribution Lines—R. M. McQuitty.

Report of Chemistry Committee—Louis Schnidman.

JULY 1—MORNING

Report of Rates and Regulations Committee—J. M. Arthur, Jr.
Report of Bulletin Publication Committee—W. H. Sanford.
Election of Officers.

The entertainment program includes a get-acquainted luncheon on Tuesday, June 28, a reception for the ladies at 8 P.M. Tuesday, a luncheon for the ladies at noon Wednesday at the Biltmore Country Club, a golf tournament Wednesday afternoon at the Baltimore Country Club, an informal dinner dance Wednesday evening at the Five Farms Club House, a trip to Annapolis Thursday afternoon, and the annual banquet Thursday evening at the Lord Baltimore Hotel.

The following companies will exhibit at the Convention: Central Station Steam Co., Spence Engineering Co., Inc., Ehret Magnesia Mfg. Co., E. B. Badger & Sons Co., Warren Webster & Co., Marsh Tritrol Co., H. W. Porter & Co., F. I. Raymond Co., American Radiator Co., The Bristol Company, and HEATING & VENTILATING.

Toronto Chapter Elects Jenney

TORONTO, ONT.—The Ontario chapter, ASHVE, held its final meeting of the 1937-38 season at the Royal York Hotel, with retiring president George Playfair in the chair. Hugh B. Jenney, sales manager of the Dominion Radiator & Boiler Co., Ltd., Toronto, was elected president for the coming term. Assisting him will be the following officers: H. D. Henion, C. A. Dunham Co., Ltd., vice-president; Harry R. Roth, secretary-treasurer.

Cyril D. Tasker, acting chairman of the code committee, reported that the committee had developed into nine sub-committees, all of which are making good progress in the compilation and gathering of data. Considerable information will be available for publication when the first fall meeting is held.

U. of Michigan Host to Coal Dealers

ANN ARBOR, MICH.—Over 300 coal dealers, stoker dealers, and fuel engineers attended the second annual Coal Utilization Institute held at the University of Michigan May 3-5.

Trends in Air Conditioning were described by Prof. Axel Marin of the University of Michigan. Coke As a Domestic Fuel was treated by Percy Nicholls of the Bureau of Mines, while I. N. Cuthbert discussed Heating the Small Residence. Prof. R. S. Hawley spoke on Stoker Coal while Prof. H. E. Keeler described and illustrated the development and application of industrial stokers.

Others on the program included J. M. Pilcher, Battelle Memorial Institute, J. E. Martin, Link-Belt Company, and A. F. H. Scott, Anthracite Industries, Inc.

Jacobs to Handle Market Research

NEW YORK—Lionel L. Jacobs, executive vice-president of Electrol Incorporated, is planning to terminate his active connection with the company, to become associated with A. L. Adams, 551 Fifth Ave., in sales and market consulting work.

Mr. Jacobs has a twenty-year record of outstanding sales and engineering accomplishments, and a wide acquaintanceship in the industry.

Taylor, Hoffman, Konzo Scheduled on Warm Air Program

COLUMBUS—The summer convention of the National Warm Air Heating and Air Conditioning Association will be held at the Plankinton Hotel, Milwaukee, June 13 to 15. The first day will be devoted to meetings of the standing committees and board of directors.

The convention proper will open Tuesday morning, June 14 at 9:30 with a special message by President L. R. Taylor, followed by an address by Prof. G. L. Larson of the University of Wisconsin.

The complete program follows:

JUNE 14—MORNING

President's talk—President L. R. Taylor.
Address—Prof. G. L. Larson, University of Wisconsin.
Some Things Successful Local Associations are Doing—J. D. Wilder, Chicago.
Humidity and Wall Condensation—Prof. L. G. Miller, head of the department of mechanical engineering, Michigan State College.
Practical Publicity Plan—H. T. Richardson, New York.

AFTERNOON

Installation Codes Committee Report—Prof. J. D. Hoffman, Purdue University.
Report and Observations—F. G. Sedgwick, chairman, research advisory committee.
Pressure Losses in Elbows and Changes in Section—Prof. A. P. Kratz, University of Illinois.
Stoker Firing-Progress Report—Prof. S. Konzo, University of Illinois.

JUNE 15—MORNING

Sound movie—Romance of Iron and Steel.
Cooling Controls for the Residence—George D. Kingsland, Minneapolis.
Let's Maintain the Position the Industry Now Enjoys—E. A. Jones, Milwaukee.
Question and Answer Hour—Conducted by B. F. McLouth and Fred Bishop.

On Tuesday evening, June 14, there will be a buffet supper and entertainment in the Plankinton provided by the L. J. Mueller Furnace Company.

Wednesday afternoon, June 15, the annual golf tournament will be held at the New Ozaukee Country Club.

Fan Manufacturers Elect C. T. Morse

DETROIT—C. T. Morse was elected president at the recent annual meeting of the National Association of Fan Manufacturers. Also elected were R. R. Ware, vice-president, and L. O. Monroe, secretary-treasurer.

The Association, now entering its twenty-second year, retains on its roster practically the same manufacturers who founded it. The membership includes American Blower Corp., Autovent Fan & Blower Co., Bayley Blower Co., Buffalo Forge Co., Clarage Fan Co., Garden City Fan Co., The Green Fuel Economizer Co., Inc., Ilg Electric Ventilating Co., The New York Blower Co., B. F. Sturtevant Co.

The next regular meeting of the Association will be held in Detroit during June.

600 Attend Anthracite Meeting

BETHLEHEM, PA.—The First Annual Anthracite Conference held here April 29 and 30 attracted a registration of 600 engineers, educators, and members of the anthracite industry. The program of the day and a half conference consisted of 18 papers dealing with new developments in the production and utilization of anthracite coal. The conference was sponsored by Anthracite Industries, Inc., in cooperation with Lehigh University.

Included in the list of speakers were President C. C. Williams, Lehigh University; President F. W. Earnest, Anthracite Industries, Inc.; Dr. Geo. H. Ashley, state geologist of Pennsylvania; Dr. H. J. Rose, Mellon Institute; Prof. H. G. Turner, Pennsylvania State College; Prof. E. S. Sinkinson, Lehigh University; Allen J. Johnson, Anthracite Industries Laboratory, Arnold Michelson, Minneapolis-Honeywell Regulator Co.; Wm. Anderson, Spencer Heater Co.; P. A. Mulcey, Anthracite Industries Laboratory; H. J. Littell, Anthracite Institute; Prof. B. H. Jennings, Lehigh University; Wm. Stein, Combustion Engineering Co.; Martin Frish, Foster-Wheeler Corp.; H. W. Warren, Glen Alden Coal Co.; Prof. A. Haring, Lehigh University; E. T. Selig, Jr., Mellon Institute; A. F. Duemler, Household Fuel Corp.; W. G. Christy, Hudson County (N. J.) Smoke Abatement Engineer, and Prof. E. C. Bratt, Lehigh University.

An exhibit of anthracite-using equipment was also arranged and exhibitors included Fairbanks-Morse, Minneapolis-Honeywell, Link-Belt, Motor Stoker, Electric Furnace-Man, Aga Stove, Vulcan Stoker, Mercoid, Burnham Boiler, Spencer Heater, Gleason-Avery, Iron Fireman, Eastern Foundry, V. M. Cruikshank, Freed Heater, Dickson & Eddy, Sarco Co., Modine Mfg. Co., D. L. & W. Coal Co., Perfex Controls, Lehigh Navigation Coal Co., Taco Heaters, Hudson Coal Co., H. A. Thrush Co., Frederick Iron & Steel Co., BAB Fireplace, Cook Electric Co., and Penn Electric.

Lehigh to Repeat Coal Conference

BETHLEHEM, PA.—As a result of the interest and enthusiasm shown at the first annual anthracite conference held at Lehigh University late in April, President C. C. Williams, of Lehigh, has announced that the conference will be made an annual affair under the joint sponsorship of the University and Anthracite Industries, Inc.

Two Firms Join Copper Association

NEW YORK—Application for membership in the Copper & Brass Research Association has been made by The Riverside Metal Co., Riverside, N. J., and The Seymour Manufacturing Co., Seymour, Conn.

Utility Service in A.C. Described

BOSTON—Members of the Air Conditioning Bureau met in the Boston Edison Auditorium May 18 for the regular monthly meeting. By request the program presented covered the general subject of "Problems of the Utility in Supplying Service for Air Conditioning Installations." Various representative sales and engineering executives covered the following subjects: "Current Characteristics", "Alternating and Direct Current Areas", "Motor Starting Requirements", "Various Motors and their Applications in Air Conditioning", "Inquiries for Service—Orders for Service", "Investigation Necessary-Costs-Rates Usually Involved." A question and answer and discussion period followed after the different speakers.

The speakers were: St. George Arnold, distributing division of the Boston Edison Company, who illustrated with charts his address on the "Engineering Problems of the Utility in Supplying Service for Air Conditioning Installations"; R. C. Allen, application engineer for the Westinghouse, who described various types of motors and their applications in air conditioning; and Paul E. Simpson, head of the rate administration division of the Boston Edison Company who told of "Sales Problems of the Utility in Supplying Service for Air Conditioning installations."

Chicago Adds 753-3/4 Tons in April

CHICAGO — Seventy-three air conditioning installations, of which 52 were central plants and 21 were room coolers. were installed in Chicago during April according to the Commonwealth Edison Company. These had a total of 753¾ tons. Included in the April installations were several large jobs including a 50-ton installation in the Church of Our Lady of Sorrows, 75 tons in the plant of the Chicago Rotoprint, 60 tons in the Alex Theatre and 50 tons in the Clark Theatre.

The Commonwealth Edison Company opened an Electric Air Conditioning Exposition in its assembly hall at 140 South Dearborn St., on May 23. Manufacturers are exhibiting all types of electric summer air conditioning equipment including store coolers, central plant systems and room coolers.

Premature Infants Thrive on A.C.

CINCINNATI—Reduction of mortality among premature infants by placing the babies in an air conditioned room with a constant temperature of 84F and a relative humidity of 65% is reported by the Children's Hospital here. The children are left in the conditioned room 24 hours.

Hospital doctors agree the humidity should average 65%, but their temperature requirements vary between 84 and 86 F.

American Radiator to Make Burner

NEW YORK—Three important equipment developments were announced May 23 by Arthur R. Herske, vice-president of American Radiator and Standard Sanitary Company. They include a new oil burner, the first produced by the company, a "packaged" steam heating system, and the thermos system using small unit heaters instead of radiators.

The new small-packaged steam system is aimed at low-cost houses and will provide for 140 to 240 sq. ft. of radiator. All fittings, controls, and accessories are boxed together, and, as each package is priced, a definite check is provided for on cost. Charts are provided to contractors and are arranged in such a manner that they can quickly estimate the actual cost of any job.

According to Mr. Herske, this simplification of installed prices quoted by the contractor and the complete packaging of the various products permit a reduction of as much as 30% under those prices previously asked by contractors, who had to estimate and calculate each individual job and make purchases for them from several sources.

"This is the first forward step in enabling contractors to sell a complete heating package to the consumer," Mr. Herske said.

The new oil burner, the first which American Radiator is bringing out under its name, will be of the pressure type and known as the Arcoflame and is priced competitively with other burners now in the field.

7 A.C. Jobs on One Waltham Street

WALTHAM, MASS.—There are seven air conditioning installations in this city on one short street, in the space of a few blocks, including the largest department store in the city, Grover Cronin's, a chain department store, a jewelry, candy, and shoe store and a candy store, in addition to a photo finishing laboratory. The Kay Jewelry Company announces that air conditioning is now a definite part of its modernization plans for all its chain. The candy store states that not only was business increased 35% over the previous year, but candy spoilage was reduced over fifty per cent through air conditioning.

Dutch Line Has 300-Ton A.C. Plant

NEW YORK—The largest air conditioning system afloat is that of the Holland-America liner *Nieuw Amsterdam* which arrived here May 16 on her maiden voyage across the Atlantic. The liner sailed May 10 from Rotterdam.

The 300-ton air conditioning system supplies the three dining salons, theater, beauty and barber shops.

ASHVE Announces Summer Program

HOT SPRINGS, VA.—The summer meeting of the American Society of Heating and Ventilating Engineers will be held at The Homestead here June 20-22. Service at the hotel is on the American plan and there will be no extra charge for the banquet to guests of the Homestead.

The committee on arrangement consists of J. A. Donnelly, I. B. Helburn, R. M. Johnston, E. W. Klein, L. F. Nordine, J. K. Peebles, and J. A. Shanklin.

The technical program follows:

MONDAY, JUNE 20
A.M.

A Test Method for Air Cleaning—R. S. Dill.
The Flow of Air Through Exhaust Grilles, A. M. Greene, Jr. and M. H. Dean.
The Condensation Nuclei Content of the Air as Related to Air Freshness—R. A. Nielsen.

TUESDAY, JUNE 21
A.M.

Heat Transfer Through Single and Double Glazing—M. L. Carr, R. A. Miller, Leighton Orr and Alan C. Byers.
Glass Heat Transfer Coefficients—D. Shore.
Performance of Surface Coil Dehumidifiers for Comfort Air Conditioning, G. L. Tuve and L. T. Siegel.

WEDNESDAY, JUNE 22
A.M.

Seasonal Variations in Effective Temperature Requirements—F. E. Giesecke, W. H. Badgett and F. C. Houghten.
Cooling Requirements for Summer Comfort Air Conditioning in Toronto—C. Tasker.
The General Reactions of 275 Workers to Summer Cooling and Air Conditioning—A. B. Newton and F. C. Houghten.
Study of Summer Cooling in the Research Residence Using a Small Capacity Mechanical Condensing Unit—A. P. Kratz, S. Konzo, M. K. Fahnestock and E. L. Broderick.

A golf tournament will be held each afternoon and the banquet and dance will be held at 7 p.m. Tuesday, June 21.

ASRE President Speaks in Midwest

KANSAS CITY—The local Section of the ASRE held a luncheon meeting April 20 to hear an address by Crosby Field, president of ASRE, and a demonstration and lecture by A. B. Schellenberg, general sales manager of Alco Valve Co.

Mr. Field's address was on "New Opportunities in Refrigeration" and covered the importance of the opportunities offered by refrigeration in the low temperature and air conditioning fields, graphically illustrating the advantages of technically trained men.

This was followed by a demonstration of the Alco glass evaporator and the lecture by Mr. Schellenberg, who explained the operation of the thermo valve, duplicating with the evaporator various conditions affecting the control of refrigerants and expained the effect of these conditions on evaporator efficiency.

Cross Talks on Burning Stoker Coal

INDIANAPOLIS—The domestic stoker, burning bituminous coal, furnishes the lowest-cost form of automatic heat for the home, according to R. C. Cross, speaking at the 8th annual meeting of the Indiana Coal Merchants Association here May 18.

Mr. Cross, a fuel engineer of Bituminous Coal Research, Inc., Battelle Memorial Institute, Columbus, Ohio, described the normal process of combustion in a stoker fuel bed as one of heating, softening, and coking of the coal, accompanied by burning of the distilled gases and partial fusion of the ash to form clinker. Coke masses or "trees" usually break down and burn automatically, a process which usually need not be interfered with, according to Mr. Cross.

Correct air control insures economy; smokeless burning and maintenance of a dependable fuel bed are other desired operating conditions. A low damper setting is advisable, and the readiest check on a proper air adjustment is the color of the flame which should be orange to yellow rather than smoky red or almost white.

The sizing of coal for use in small stokers, types of control equipment, and other common problems were urged by the speaker as deserving the coal dealers' close attention. The underfeed stoker, he said, despite the more than 300,000 units already installed, has only begun to exploit the potential field of automatic domestic heating.

Mr. Cross used current prices of the Indianapolis area in making his comparisons of heating costs, but stated that prices in most parts of the country would likewise indicate the relative economy of bituminous coal for this service.

Kratz Addresses Power Conference

CHICAGO—The 1938 Midwest Power Conference sponsored by Armour Institute of Technology with the cooperation of six midwestern state engineering schools was held in the LaSalle Hotel here during April.

Among the papers on the program was one by Prof. A. P. Kratz, research professor of mechanical engineering, University of Illinois, who spoke on "Power Requirements for Residential Air Conditioning."

Professor Kratz said that power requirements of a fan in an air conditioning system are dependent on the design of the particular fan, motor, and duct system and on the range of bonnet air temperature selected for the heating of the bonnet thermostat. He presented numerous graphs showing power requirements for hand-fired forced air heating systems, oil-fired forced air systems, and for summer cooling at the Research Residence.

Price Elected President by ACMA

HOT SPRINGS, VA.—High blood pressure and nervous and mental diseases keep pace with the steadily swelling volume of city noise and have become a recognized public health problem of increasing gravity, Dr. A. G. Young, director of the Corey Hill Hospital, Brookline, Mass., told the annual meeting of the Air Conditioning Manufacturers' Association, held here during May.

Citing the increased installation of air conditioning equipment for control of atmospheric and temperature conditions for industrial, business and residential use, Doctor Young predicted that its most consistent adoption would be in the country's hospitals and sanitariums.

William H. Price, Jr., Carrier Corporation, was elected president of the Association. Others elected were J. J. Donovan, General Electric Co., vice-president, and P. A. McKittrick, Parks-Cramer Co., treasurer.

Stokers Reduce Domestic Smoke

NASHVILLE, TENN.—Installation of underfeed stokers in homes would solve the domestic smoke problem of the cities in a highly satisfactory manner, according to E. R. Kaiser, fuel engineer, who spoke before the 32nd annual convention of the Smoke Prevention Association here May 18.

Mr. Kaiser, assistant fuel engineer, Bituminous Coal Research, Inc., Battelle Memorial Institute, drew on the results of extensive field surveys and laboratory studies to show the smoke reduction obtained by substituting stokers for the hand-firing methods now prevalent.

Using data representative of conditions in an ordinary eight-room house on a typical winter day, Mr. Kaiser showed that the smoke produced with a stoker burning high-volatile coal was only about one eighth the total quantity that would have been released into the air had the furnace been fired by hand.

French Investigate A.C. for Babies

PARIS—Spurred by the high infant mortality during summers of unusual heat in France, experimental work has been in progress at the Sorbonne in Paris to determine the most favorable conditions of temperature and ventilation for children less than a year old, according to "Recherches et Inventions." A "berceau optimotherme" developed by Doctor Baccino, which may be described as an enclosed cradle air conditioned to maintain a uniform temperature regardless of fluctuations in the weather, is recommended for use during hot spells in France, and especially in certain equatorial colonies where infant mortality is occasionally as high as 50%.

McIntire Addresses Pittsburghers

PITTSBURGH—Pittsburgh chapter of the ASHVE met May 16 at Stouffer's restaurant with President J. F. Collins, Jr., presiding. A number of visitors were present including members of the research committee—J. J. Aeberly, Walter L. Fleisher and J. H. Walker.

The speaker of the evening was J. F. McIntire, U. S. Radiator Corp., second vice-president of the national society, who represented the boiler rating committee and presented to the chapter a tentative form for rating boilers that is being worked up by the committee. The talk was well received, and was followed up with a discussion by the members.

The chapter has inaugurated a student committee, a member of which, George Cost, senior at Carnegie Institute of Technology, gave a lecture on panel heating. He outlined the history, physiological effects and practical applications of panel heating.

Mr. Fleisher was asked to say a few words about his recent trip to Europe. He discussed the subject of panel heating, and said that the main reason for its use in England is the mild climate. The desire on the part of the English to keep the heating equipment such as radiators out of the living room is one reason for its demand. The fireplace is often used as a supplement to panel heating. There is a delay and lag in controlling temperature with panel heating that is objectionable. Mr. Fleisher said that the English underheat their homes as compared with our standard.

Designers to Confer on Conditioning

NEW YORK—The first conference of interior designers ever held to discuss air conditioning, the types of equipment and applications and the relationship of air conditioning to interior design of residences and apartment, office, business and commercial structures will be held here June 7-8 at the Waldorf-Astoria Hotel. There will be a session each morning.

The conference is sponsored by the publication *Interior Design and Decoration*. Charles S. Leopold, Philadelphia consulting engineer, will serve as chairman.

Mining Engineers Appoint Johnson

PRIMOS, PA.—Allen J. Johnson, director of the Anthracite Industries Laboratory, has been appointed to membership on the committee of research of the coal division of the American Institute of Mining and Metallurgical Engineers, according to D. R. Mitchell, secretary of the Institute.

Mr. Johnson's work on combustion of anthracite has received wide recognition from engineers throughout the country.

New Name for Insulation Makers

NEW YORK—Manufacturers of mineral wool have announced the new name of their organization—The National Mineral Wool Association. This group, which produces about 95% of the mineral wool manufactured for home and industrial insulation, formerly was known as the National Rock & Slag Wool Association. The new name, adopted by unanimous vote of the member companies, was announced by Wharton Clay, secretary. The association has its headquarters in Rockefeller Center.

Mineral wool is the generic term for the insulating material manufactured from rock, slag, and glass by heating it to high temperatures and drawing the molten material into long, continuous fibers with high pressure jets of steam. The product has been known and used for home insulation since about 1887, but only within the last decade has it become a leading material for both home and industrial insulation.

Telephone Booth Air Conditioned

ATLANTA—An air conditioned telephone booth is a feature in a local bank, the First Federal Savings and Loan Association building. When the building was conditioned, the installation was extended to include a lobby telephone booth, said to be the smallest space ever air conditioned for public comfort.

An engineering problem involved in air conditioning such a small space was the control of the circulation of the conditioned air. A special outlet grille was placed in the top of the booth and the velocity of the air released was checked in the ducts by an improvised "air brake." The installation is by Carrier.

Vernon Elected by Chicago ASHVE

CHICAGO—The Illinois chapter of the ASHVE closed its 1937-1938 season with a dinner-dance-business meeting at the Bismarck Hotel, May 9. One hundred and fifteen members, ladies and guests were present to honor E. Holt Gurney, national president, and Mrs. Gurney, who were visiting the chapter for this occasion.

President S. I. Rottmayer introduced Mr. Gurney who talked on the importance of the Society, its functions and its objectives. He stressed the need for clarifying the meaning of "air conditioning" to the public.

Officers for the coming year were elected, as follows: J. R. Vernon, president; Tom Brown, vice-president; M. W. Bishop, secretary; E. M. Mittendorff, treasurer. The board of governors will consist of Irving E. Brooke, V. L. Sherman, J. H. Van Alsburg, and S. I. Rottmayer.

Indiana Coal Men Meet at Purdue

LAFAYETTE, IND.—The Indiana Coal Conference was held at Purdue University here April 28-29, sponsored by the school of mechanical engineering and the engineering extension department of the University in cooperation with the Indiana Coal Merchants' Association and the Coal Trade Association of Indiana. Prof. H. L. Solberg of Purdue was conference chairman.

Among the speakers were Ralph A. Sherman, Battelle Memorial Institute, who spoke on the preparation of coal for domestic stokers; Prof. W. T. Miller of Purdue University, who discussed trouble shooting in residential heating plants, and E. K. Scoggin, Minneapolis-Honeywell Regulator Co., who explained control problems of the domestic stoker. Professors G. A. Young, A. W. Cole, and J. D. Hoffman, all of Purdue, also cooperated in the conference.

Missenard to Serve on Committee

NEW YORK—W. L. Fleisher, chairman of the committee on research of the ASHVE, has announced the appointment of André Missenard, French scientist and authority on air conditioning, to the society's technical advisory committee on physiological reactions. M. Missenard is senior scholar of the Polytechnic School; professor of the Special School of Public Works and conference advisor at the National Beaux Arts High School of Paris; the author of "L'Homme et Climate" and other works dealing with man and his atmospheric environment.

M. Missenard will also serve on the ASHVE committee on Climate and Season.

Fuel Burning Warms Atmosphere

LONDON—A lecture on the Artificial Production of Carbon Dioxide and its Influence upon Surface Temperature was recently delivered here by G. S. Callendar before the Royal Meteorological Society. Mr. Callendar said that by fuel combustion man has added about 150,000,000,000 tons of carbon dioxide to the air during the past 50 years. He estimated from the best available data that approximately three-fourths of this amount has remained in the atmosphere.

The lecturer used the radiation absorption coefficients of carbon dioxide and water vapor to show the effect of carbon dioxide on sky radiation. The increase in the mean temperature, due to the artificial production of carbon dioxide was estimated to be at the rate of 0.003C per year at the present time. The temperature observations at 200 meteorological stations show that world temperatures have actually increased at an average rate of 0.005C per year during the present half century.

Porter Talks on Oil vs. Gas Costs

ASBURY PARK, N. J.—G. Harvey Porter, managing director of Oil Burner Institute, was one of the speakers at the recent convention here of The Fuel Oil Distributors Association of New Jersey. Mr. Porter made a presentation of the subject Fuel Oil vs. Gas Heat with a view to providing material for use by oil and burner dealers in combating local gas competition.

He pointed out that the gas companies enjoy certain natural advantages in public approach based on general consumer acceptance of public utilities products which home owners have been using over a long period of years, together with the closely knitted organization of the gas companies, and their national cooperative advertising campaign, while local oil burner groups have been sitting by making no concentrated effort to meet it.

Mr. Porter stressed the importance of securing and working with facts, and pointed out the broad research conducted by Oil Burner Institute in all principal key markets with respect to actual costs of heating with oil compared to gas, and based entirely upon factual findings widely verified before release.

The results of this survey were submitted by Mr. Porter to the group in the form of the OBI published booklet "Fuel Oil vs. Gas Heat," together with an especially prepared study and chart of oil and gas costs affecting the principal cities of New Jersey, in the area in which his listeners were doing business.

Mr. Porter stated that this survey definitely places gas at such a disadvantage from a standpoint of comparative cost with fuel oil, that except for a few cities where there is natural gas, it really is not a problem at all. He brought out the fact that there were arguments that have been used from time to time in competition with other fuels in which a play has been made to the known deficiencies of those fuels, but that he felt no good purpose was served in approaching the public from this angle.

Mr. Porter emphasized the desirability of some form of common symbol to be adopted by all in the industry as a banner to the public, to be used by all fuel oil and burner dealers, large refiners, etc., in their advertising, literature, booklets, trucks, etc. He also reported on the present status of discussions with respect to national cooperative advertising of fuel oil.

NDHA Boston Group Visits Arsenal

BOSTON—Members of the Boston Section, National District Heating Association, and invited guests held their 12th semi-annual meeting May 26. They made tours of the United States Arsenal at Watertown, Mass., inspecting the steam distribution system, and machines for X-ray of heavy metals and later in the afternoon assembled at the Hood Rubber Company in the same town, there inspecting the steam distribution system and the application of steam in the processing of rubber, together with time motion study work. Dinner was served in the Hood Rubber Company's restaurant, and was followed by a talk by a member of the Watertown Arsenal staff and then by a talk and motion picture on plant operations and time motion studies.

ANSWER TO THE PROBLEM ON PAGE 49

Each house required the same number of connections; let this number = X. Then Frank made all the connections in one house less the 3 that Joe made plus 6 in Joe's house, so that Frank made (X — 3) + 6 connections. Joe installed 3 in Frank's house plus all in his own less the 6 that Frank did, or 3 + (X — 6). Frank thus made X + 3 connections, Joe X — 3 connections. Frank therefore made (X + 3) — (X — 3) = 6 more connections than Joe did.

New York Utility is Promoting A.C.

NEW YORK — Eight manufacturers and distributors of portable air conditioning equipment are cooperating with the Consolidated Edison Company of New York, Inc., in a summer advertising campaign featuring air conditioning units for offices and homes, according to E. F. Jeffe, vice-president in charge of sales.

Leading metropolitan dailies are being used as well as direct mail. Those participating include: Westinghouse, Airtemp, Delco-Frigidaire, Carrier, General Electric, Kelvinator, Standard Air Conditioning, and York.

J. L. Rosenmiller Addresses ACMA

PHILADELPHIA—"The secret of sales promotion is to keep your personnel up-to-the-minute on every new development made by your organization," stated J. L. Rosenmiller, chairman of the ACMA advertising and publicity relations committee, before a meeting of the Eastern Industrial Advertisers Organization, here recently. Mr. Rosenmiller is manager of the sales promotion division of York Ice Machinery Corporation.

In his talk, Mr. Rosenmiller discussed the distribution of sales literature, with adequate instructions for its use, to the sales organization. He also stressed the importance of preparing other devices for obtaining publicity and aiding sales, such as: direct mail campaigns, equipment exhibits, moving pictures and window displays.

ASA to Study Dusts and Fumes in Air

NEW YORK—By action of the Standards Council, the American Standards Association has released its Advisory Committee on Exhaust Ventilation from its restrictions as an advisory committee and given it authority to develop standards for safe limits of concentration of toxic dusts and gases in air. It is probable that the committee will establish some standard procedure for analyzing the concentration of dust in air and, in general, institute new and additional research into the problem of dust and gases in air.

The committee is being organized as a scientific or non-commercial sectional committee and includes many experts with experience and special knowledge of the problems involved. Dr. R. R. Sayers, Senior Surgeon, U. S. Public Health Service, is chairman of the committee, and Dr. R. R. Jones, U. S. Public Health Service, has been appointed technical secretary. Other members of the committee include Prof. Philip Drinker of Harvard; Theodore Hatch, New York Department of Labor; W. P. Yant, formerly of the Bureau of Mines and now with the Mines Safety Appliances Corp., a large number of doctors of medicine with various corporations and a few engineers.

WPA to Examine Marketing Laws

WASHINGTON—Approval of a project to survey state marketing laws throughout the United States was announced recently by Corrington Gill, assistant administrator of the Works Progress Administration. The survey is designed to obtain legal and economic data concerning laws on the state statute books and make it available in useful form to all federal and state governmental agencies, trade associations, businessmen, lawyers, students and teachers of law and marketing.

Laws to be examined include: state anti-trust and anti-price-discrimination laws; laws which affect miscellaneous marketing methods, and laws pertaining to the marketing of specific products.

William Kinsley Glen

CLEVELAND—William K. Glen, manager of Crane Company's Cleveland branch, died April 28 at the Lakeside Hospital here following a week's illness of pneumonia. He was 60 years old.

Associated with Crane since 1904, Mr. Glen was advertising manager of the company from 1922 to 1932 when he was made district manager of the Chicago metropolitan district. He became manager of the company's boiler and radiator department in 1934. In 1936 he was made manager of the Cleveland branch.

Mr. Glen is survived by his wife and daughter.

NEW EQUIPMENT

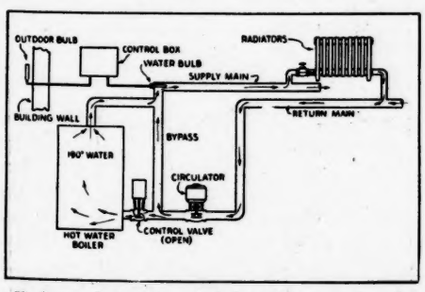
Hoffman Hot Water Heating System

NAME—Hoffman hot water controlled heating system.

PURPOSE—A specially controlled forced hot water heating system for buildings.

FEATURES—The manufacturer states that this system will successfully maintain a uniform room temperature under all conditions. The basic principles of this system are: (1) continuous circulation of the water in the system; (2) the boiler is bypassed from the rest of the circulating system; and (3) temperature control based on a balanced condition between outdoor and radiator temperatures. The system consists of the regular boiler, supply and return mains, radiators or convectors, expansion tank and relief valve, and a Hoffman circulating pump, control valve and a temperature controller with outdoor and water temperature bulbs. In operation, the boiler is maintained at a constant temperature in accordance with the desired heat emission. The pump runs continuously except when the outdoor temperature rises to about 65F. The piping differs from the conventional layout in that a bypass and a Hoffman control valve are installed between the pump and the boiler. Unless the control valve is open, the water circulating continuously through the piping and radiators does not pass though the boiler. Water circulating through the pipes and radiators is automatically held to the temperature which offsets the heat loss of the building at any given outdoor temperature. For example, if outdoor temperature is 40F, the water circulating through the radiators of a system designed for 10F below zero will be 118F. This control is accomplished by the water temperature bulb installed in the supply main close to the boiler. When the water in the circulating system drops below 118F, the water bulb sends a call for heat to the Hoffman temperature controller. This temperature controller in turn causes the control valve to open, admitting hot water from the boiler into the circulating system. When the outdoor temperature changes the outdoor bulb goes into action. If the temperature falls, the outdoor bulb causes the temperature controller to maintain a higher water temperature. When the outdoor temperature rises, the temperature controller maintains a lower water temperature. The manufacturer states that radiators cannot heat up during summer operation when the boiler is kept operating to supply domestic hot water because of the control valve in the return main and the drop design of the supply main.

MADE BY—*Hoffman Specialty Co., Inc., Waterbury, Conn.* 1



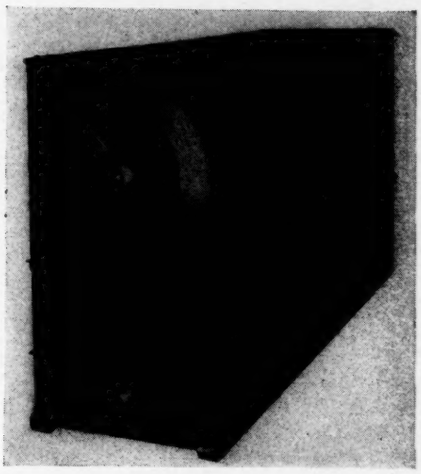
Hoffman hot water system with control valve open. When radiator temperature is too high control valve closes and bypasses water around boiler.

Marley Cooling Towers

NAME—Small induced draft cooling towers.

PURPOSE—For supplying cooling water to equipment of small capacity.

FEATURES—This is a complete series of small steel-cased induced draft cooling towers, including horizontal wood filled types for use indoors and vertical types for outdoor service, either



wood or spray filled. Towers incorporate all the features of the larger Marley mechanical draft units, including patented non-clog spray nozzles of bronze and galvanized steel pipe headers and nozzle arms. Indoor towers are horizontal in construction and in air movement. Casings and basins are 16 gage copper bearing steel, shop painted two coats. Zig-zag drift eliminators of heart redwood and cast iron spacers are built as one unit, easily lifted out for access to the tower interior. Removable redwood decks and spacers constitute the filler through which the water filters down after down-spray injection at the top. Towers are shipped fully assembled ready for operation. The vertical outdoor towers are available in either wood-fill or spray-fill types and are equipped with multiple-effect drift eliminators of heart redwood with cast iron spacers and Marley fans having V-belt drives. In the wood-fill type water is uniformly sprayed at the top and decking is of heart redwood. Two levels of down-spray nozzles are provided in the spray-fill types. Both types are shipped in knocked down, easily handled units.

SIZES AND CAPACITIES—28 models with four standard sizes of indoor towers ranging from 2½ ft. x 7½ ft. x 3 ft. 2½ in. to 2½ ft. x 8½ ft. x 6 ft. 8½ in. Each type of outdoor tower is available in 12 standard sizes from 2½ ft. x 2½ ft. x 9 ft. 1 in. to 10 ft. x 10 ft. x 14 ft. 3 in.

MADE BY—*The Marley Co., 3001 Fairfax Rd., Kansas City, Kan.*.....2

Young Remote Control Regulator

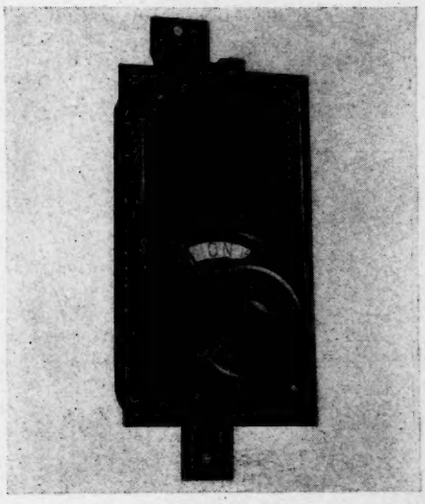
NAME AND MODEL NUMBER—Young remote control regulator, Model 700.

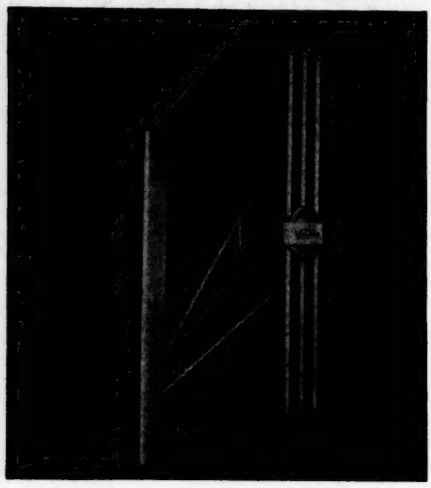
PURPOSE—For manually regulating the position of dampers from a remote location.

FEATURES—This device can be installed in an accessible location to control the operation of dampers or registers located at a distance. The regulator consists of a wall box, control mechanism, escutcheon and 7 ft. of stainless steel cable with an outer casing of 3/16 in. stainless steel wire and one stainless steel spring. Additional cables may be obtained if desired. The control box is placed at a convenient place and the figures on the dial tell how far the damper is open. The device is so constructed that the damper is regulated at all times by pulling on a wire and not by pushing. To secure this action a spring is used to close the damper and return the wire to its original position when the regulator releases the spring. A ratchet wheel is provided to lock the damper in position so that the wire can't slip.

LITERATURE AVAILABLE—Bulletin 10.

MADE BY—*Young Regulator Co., 4500 Euclid Ave., Cleveland, Ohio*.....3



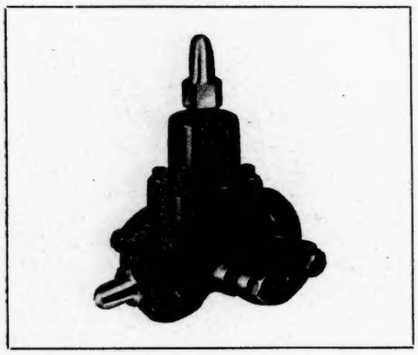


American Blower Attic Fan

NAME—Ventura home conditioner.
PURPOSE — For residential cooling using night air.
FEATURES—This unit incorporates a number of features to give quiet operation, including a streamlined air inlet, rubber mounting of motor and also rubber mounting of the acoustically treated housing. A safety guard in the form of an attractive grille is available for open installations. Unit may be installed in louvered sidewall opening or in a suction box over the ceiling grille. Fan is housed in sheet steel which is finished in black morocco crinkle.
SIZES AND CAPACITIES—Six sizes with capacities ranging from 7500 to 21,500 c.f.m.
MADE BY—*American Blower Co., Detroit, Mich.* 4

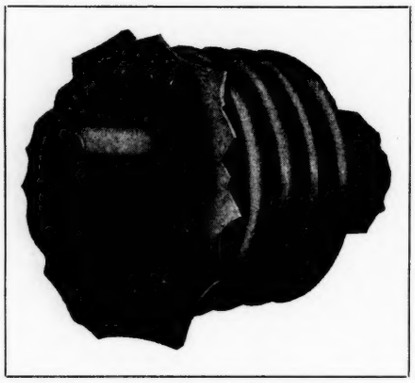
Hubbell Back Pressure Regulator

NAME AND MODEL NUMBER—Back pressure regulator, type SA-2 for ammonia and SF-2 for Freon.
PURPOSE—For maintaining a fixed back pressure in cooling coils of plants using ammonia or Freon as a refrigerant.
FEATURES—Accurate regulation adjustable over a wide range of pressures with variable loads. Flanged connections, tapped for iron pipe size in ammonia valves, or fitted with streamline fittings for copper tube connections in Freon valves. Regulator is said to be compact and has a diaphragm-controlled pilot valve, power piston, and manual opening stem.
SIZES AND CAPACITIES—Made in port sizes from ¾ in. to 8 in. with capacities depending on the refrigerant and its temperature.
MADE BY—*Hubbell Corp., 1315 Carroll Ave., Chicago, Ill.* 5



Badger Pipe Line Flexible Seal

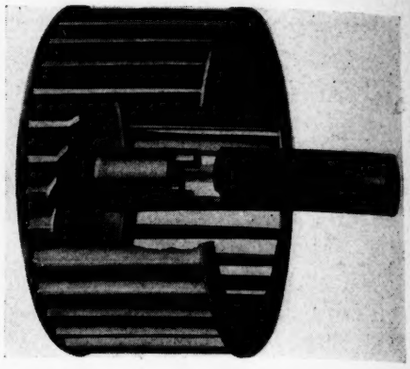
NAME—Pipe line flexible seal.
PURPOSE—For making watertight and leakproof the opening where steam piping passes through foundations or walls below ground or flood level.
FEATURES—This device is made up of a flexible member which is corrugated by a special process from a single tube. One end of the seal is fitted with a nipple that can be welded to the outside of the pipe which is to pass through the wall. The opposite end can be fitted with either a nipple for welding or a flange for bolting to



bulkhead, deck or wall plate. If it is desired, this fitting can be furnished with a special combination sleeve and flange for grouting into a flood wall. This seal is said to make it possible for piping to be carried through bulkheads, decks or walls with allowance for expansion, contraction, lateral displacement and vibration while at the same time providing a watertight connection. These seals are manufactured in both ferrous and non-ferrous metals.
LITERATURE AVAILABLE—Bulletin No. 300.
MADE BY—*E. B. Badger & Sons Co., Boston, Mass.* 6

Lovejoy Flexible Couplings

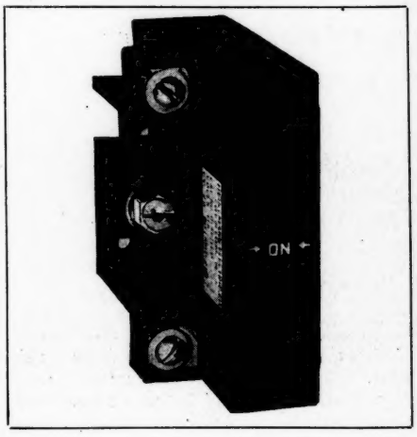
NAME AND MODEL NUMBER—L-R Double-flex flexible coupling, style UX.
PURPOSE—For transmitting power not in excess of ¼ hp. to oil burners, refrigerators, and other like applications.
FEATURES—This device consists of two jaw units and a cushion unit, made of a solid, tube-shaped section with the center composed of hard rubber and the ends where it contacts the

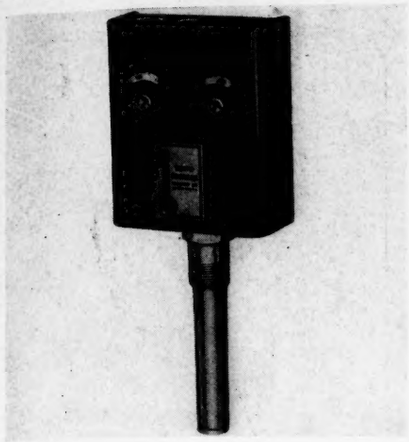


jaws fashioned out of a more resilient rubber. This assembly is said to produce a coupling which is strong, flexible, smooth-running and noiseless. The manufacturer states that it is possible to purchase from fan makers fans with a hub built in the form of an L-R flexible coupling jaw (see illustration). If this is done, only two units have to be purchased to complete the coupling, that is, one hard rubber center piece and one jaw. Besides this economy, it is said that the coupling makes possible the use of short shaft motors.
MADE BY—*Lovejoy Flexible Coupling Co., 5009 W. Lake St., Chicago*.....7

Heinemann Motor Overload Control

NAME—Re-Cirk-It auxiliary breaker.
PURPOSE—For the protection of fractional horsepower motors up to 1 hp. in ratings from 250 milliamperes to 35 amperes.
FEATURES—A magnetic time delay unit takes care of harmless overloads while it opens on heavy overloads and short circuits. Magnetic blowout contacts are said to be capable of withstanding short circuits and reduce arching to a minimum. A tumbler type handle moves one way to close, the other to open and indicates on and off. All moving parts except the handle are enclosed in a black bakelite case with 3 7/32 x 1⅞ x 2 11/16 in. in dimension.
MADE BY — *Heinemann Electric Co., Trenton, N. J.* 8



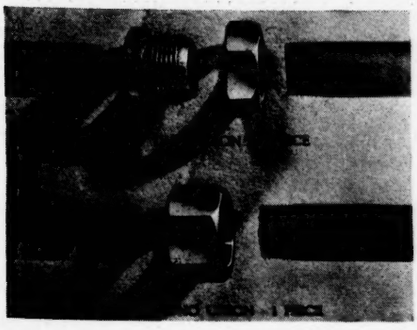


White-Rodgers Hot Water Control

NAME—Dual immersion "hydraulic action" hot water control.
PURPOSE—A control for maintaining both the hot water supply and boiler water temperatures.
FEATURES—This device is said to make it possible to control both the hot water supply and boiler water temperatures with a single instrument. This is accomplished by two separate switches, each having individual thermal element and permitting individual setting. The control utilizes the available tapping in the boiler which makes it unnecessary to drill another hole in the boiler, as is now sometimes required by the use of individual immersion type controls. Each switch has its own individual adjustable differential with ranges of 5 to 35F. Control is available with either vertical or angle mounting. Control utilizes the White-Rodgers "hydraulic action" principle.
MADE BY—*White-Rodgers Electric Co., St. Louis, Mo.* *9*

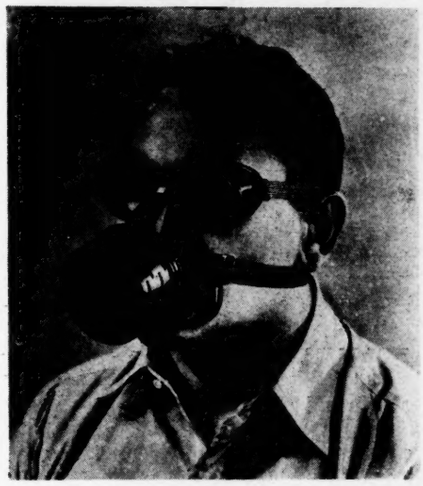
Colonial Pipe Unions

NAME—Two-piece Duo union and one-piece Mono union.
PURPOSE—Simplified unions for joining threaded pipe.
FEATURES—These new unions are said to be lower in price because there are fewer operations and machining and the total weight is reduced approximately one-third to one-half. The manufacturer states that since more than half the parts required in standard unions are eliminated, possibilities of leakage are reduced. It is said that the unions can be used over and over again since no damage is done to the seats when they are installed. It is claimed that they will withstand great horizontal and vertical stresses.
MADE BY—*Colonial Stove Co., E. Somerset and Trenton Ave., Philadelphia, Pa.* *10*



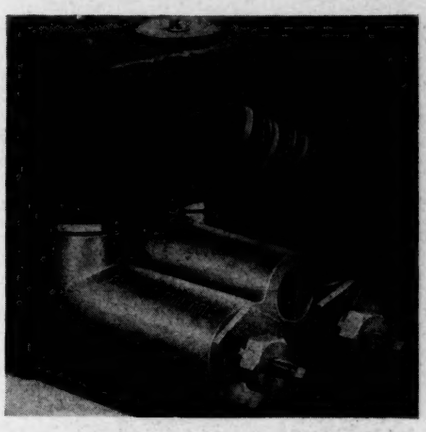
American Optical Respirator

NAME—American Optical respirator.
PURPOSE—To prevent silicosis.
FEATURES—Compactness, light weight, unobstructed vision, improved valves to ease inhalation and exhalation, large filter area (42 sq. in.) and no facial adjustment necessary. Respirator has been approved by the U. S. Bureau of Mines for Type A dusts.
MADE BY—*American Optical Co., Southbridge, Mass.* *11*



G-E Conversion Oil Burner

NAME—G-E oil burner.
PURPOSE—For converting boilers and furnaces for oil burning.
FEATURES—This burner operates at from 8 to 15 lb. pressure and utilizes compressed air for atomization of the oil. Because of this the manufacturer states that a large orifice can be used, thus reducing the chances of clogging with dirt and carbon. A high-pressure fan is used on the burner to minimize the effect of draft variation. A vane-type oil pump is used and is said to be capable of drawing oil from tanks as far as 15 ft. below the burner. The motor compressor unit and controls on this burner are the same as those used on the G-E furnace. A gray metal jacket encloses all parts and wiring of the burner. The unit is said to burn No. 2, 3, or 4 fuel and the oil flow is kept at a constant rate by a stabilizer regardless of the viscosities of the various grades of oil.
SIZES AND CAPACITIES—Available for oil rates of ¾ to 3 gal. per hr.
MADE BY—*General Electric Co., Bloomfield, N. J.* *12*

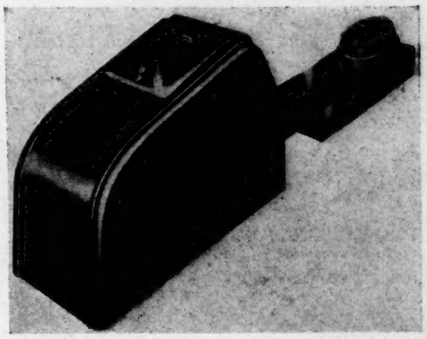


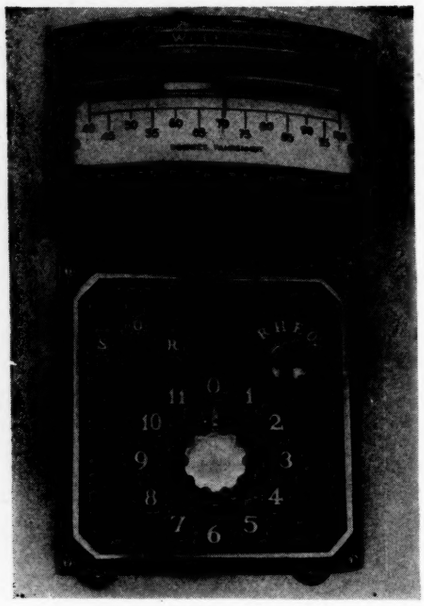
General Controls Magnetic Valve

NAME AND MODEL NUMBER—General Dual K-10.
PURPOSE—For hi-low fire or hi-low flow control.
FEATURES—This valve has two electrically independent solenoids operating two lever-action, high-pressure valves. The lever-action is said to develop six times the opening and closing power of straight magnetic valves and the manufacturer claims that this valve will handle oils as heavy as No. 6 at usual room temperatures or steam up to 125 lb. pressure. Flow adjustments are provided on both ports. The valve is packless, is normally closed and has an energy consumption of 14 watts per solenoid.
MADE BY—*General Controls Co., 450 E. Ohio St., Chicago, Ill.* *13*

Peerless Stoker

NAME—Peerless stoker.
PURPOSE—For automatic burning of coal.
FEATURES—Some of the more important features of this stoker are continuous feed, gear transmissions with three rates of coal feed, hood soundproofed with plastic material, automatic air control and specially adapted wind boxes to suit practically all furnace and boiler installations, sectional tuyeres designed to prevent smoke backing up in the hopper, and completely sealed hoppers. Stoker is finished in a blue-green lacquer.
MADE BY—*Peerless Manufacturing Corp., Louisville, Ky.* *14*





Wheelco Indicating Resistance Thermometers

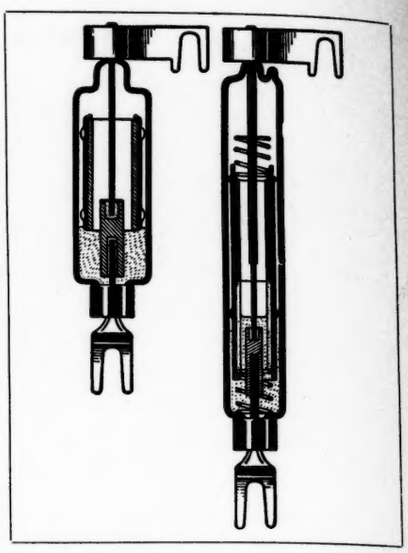
NAME—Indicating resistance thermometers.
PURPOSE—For remote readings of temperature in rooms, air ducts, bulk material in bins and like applications where the temperature ranges from —30F to + 250F.
FEATURES—This instrument will show at one central point the temperatures at a number of different points. The resistance thermometers are made in several models and may be equipped with a multiple switch for connecting up to 21 temperature bulbs located at as many different points in an air conditioning system. Suitable temperature bulbs can be furnished for any application. All instruments are furnished with an aluminum case with a black enamel finish.
MADE BY—*Wheelco Instruments Co., 1933 S. Halsted St., Chicago, Ill.....15*

Spencer Motor Thermostat

NAME—Klixon motor protection thermostat.
PURPOSE—Thermostat consists of a small thermostatic bimetal disc placed next to a heater wire. Contacts welded to the disc provide positive action and since they are placed in series with the line circuit, they will break the circuit when open. The thermostat is designed to protect the motor from overheating from any cause, yet interferes with the motor operation only when the overheating is a definite danger to the motor. The manufacturer states that in operation the thermostat follows closely the heat rise in the motor windings, compensates automatically for varying ambient versus load conditions and permits the motor to operate up to its peak safely under all conditions. The thermostat is applicable over the complete range of single phase a.c. fractional horsepower motors up to and including 1 hp. 110 and 220 volts. Available with either manual or automatic reset.
MADE BY — *Spencer Thermostat Co., Attleboro, Mass. 16*

Vertex Mercury Relay

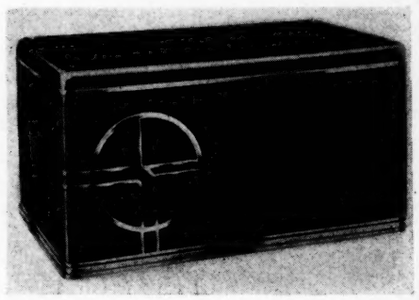
NAME—Vertex non-tilting mercury relay.
PURPOSE—A mercury type switch for making or breaking an electrical circuit.
FEATURES—The Vertex relay consists of a vertical tube surrounded by a solenoid. The tube contains a cylindrical plunger which floats on a mercury bath. When the solenoid is energized, this plunger is drawn downward magnetically, thereby displacing the mercury which rises and makes contact with the upper electrode. In this relay the mercury tube remains stationary and the mechanical motion takes place completely within the hermetically sealed tube. Two types



are available, the normally open type and the normally closed type. The normally open type operates as explained previously, while in the normally closed type the plunger displaces the mercury by its own weight. The magnetic action of the coil is used to lift the plunger, thus causing the mercury level to fall and to break the contact. The tubes of the relays are filled with inert gas especially suited to prevent oxidation. Left-hand illustration shows normally open type, while the one at the right shows normally closed type.
FOR SALE BY—*Dr. F. Lowenberg, 10 E. 40th St., New York. 17*

Johnson Space Cooler

NAME—Johnson space cooler.
PURPOSE—A window unit for cooling small rooms.
FEATURES—Unit is designed to set on a windowsill and heat is removed by the circulation of outside air over a large condenser. The manufacturer states that extensive use has been made of sound absorbing material to insure practically noiseless operation. A 1/3-hp. belt-tightener type motor drives a twin-cylinder compressor and condenser air fan. A small separate motor is used to circulate approximately 200 cu. ft. of air per min. Current load is about 400 watts. Unit is priced at $150 retail.
CAPACITY—4000 B.t.u. per hr.
MADE BY—*Johnson Motors, Waukegan, Ill. 18*



TO OBTAIN FURTHER INFORMATION ON NEW EQUIPMENT

On the list below circle the item number of the equipment in which you are interested, using the identifying number found at the end of each description

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Fill in your name and address, detach and mail to
HEATING & VENTILATING
148 Lafayette St.,
New York, N. Y.

Name .....

Title .....

Firm .....

Business Address .....

City and State 6/38

Degree-Day Figures for April, 1938

HEATING & VENTILATING continues its tenth year of publishing degree-day data for various large cities

	Albany, N. Y.	Atlanta, Ga.	Baltimore, Md.	Birmingham, Ala.	Boston, Mass.	Buffalo, N. Y.	Burlington, Vt.
Degree-days for April, 1938.....	438	152	284	140	496	585	610
Degree-days, Sept. 1, '37 to Apr. 30, '38	5972	2820	4070	2435	5604	6336	7264
Degree-days, Sept. 1, '36 to Apr. 30, '37	5937	2698	4092	2351	5455	6253	7217
Degree-days, Sept. 1, to Apr. 30, Normal	6397	2890	4511	2352	5800	6475	7238

	Cheyenne, Wyo.	Chicago, Ill.	Cincinnati, Ohio	Cleveland, Ohio	Columbus, Ohio	Denver, Colo.	Des Moines, Iowa
Degree-days for April, 1938.....	677	456	289	459	341	477	417
Degree-days, Sept. 1, '37 to Apr. 30, '38	6486	5738	4693	5522	5030	4999	5920
Degree-days, Sept. 1, '36 to Apr. 30, '37	7291	6019	4826	5521	5091	5927	6601
Degree-days, Sept. 1, to Apr. 30, Normal	6894	6042	4684	5935	5311	5607	6266

	Detroit, Mich.	Dodge City, Kan.	Duluth, Minn.	El Paso, Tex.	Erie, Pa.	Evansville, Ind.	Fort Wayne, Ind.
Degree-days for April, 1938.....	512	369	779	134	497	219	440
Degree-days, Sept. 1, '37 to Apr. 30, '38	6138	4554	8573	2130	5858	3990	5813
Degree-days, Sept. 1, '36 to Apr. 30, '37	6225	5282	9312	2747	5757	4312	5907
Degree-days, Sept. 1, to Apr. 30, Normal	6264	4988	8721	2428	6016	4244	5795

	Fort Worth, Tex.	Grand Rapids Mich.	Green Bay, Wis.	Harrisburg, Pa.	Hartford, Conn.	Indianapolis, Ind.	Ithaca, N. Y.
Degree-days for April, 1938.....	144	514	585	364	436	358	523
Degree-days, Sept. 1, '37 to Apr. 30, '38	2124	6144	7254	5036	5604	5151	6157
Degree-days, Sept. 1, '36 to Apr. 30, '37	2728	6272	7598	5021	5503	5289	6308
Degree-days, Sept. 1, to Apr. 30, Normal	2148	6361	7503	5285	5834	5239	6477

	Kansas City, Mo.	Knoxville, Tenn.	La Crosse, Wis.	Lansing, Mich.	Lincoln, Neb.	Little Rock, Ark.	Los Angeles, Calif.
Degree-days for April, 1938.....	307	157	493	540	352	148	134
Degree-days, Sept. 1, '37 to Apr. 30, '38	4615	3317	6810	6514	5460	2775	966
Degree-days, Sept. 1, '36 to Apr. 30, '37	5194	3197	7538	6701	6246	3186	1390
Degree-days, Sept. 1, to Apr. 30, Normal	4840	3670	7139	6819	5900	2811	1414

	Louisville, Ky.	Madison, Wis.	Memphis, Tenn.	Milwaukee, Wis.	Minneapolis, Minn.	Nashville, Tenn.	New Haven, Conn.
Degree-days for April, 1938.....	232	528	138	543	577	159	450
Degree-days, Sept. 1, '37 to Apr. 30, '38	4163	6802	2817	6332	7403	3318	5328
Degree-days, Sept. 1, '36 to Apr. 30, '37	4353	7319	3181	6659	8118	3472	5255
Degree-days, Sept. 1, to Apr. 30, Normal	4180	7193	2950	6856	7614	3507	5672

	New Orleans, La.	New York, N. Y.	Norfolk, Va.	Oklahoma City, Okla.	Omaha, Neb.	Peoria, Ill.	Philadelphia, Pa.
Degree-days for April, 1938.....	66	372	175	233	368	377	318
Degree-days, Sept. 1, '37 to Apr. 30, '38	1204	4777	3132	3400	5771	5513	4515
Degree-days, Sept. 1, '36 to Apr. 30, '37	1087	4748	3018	3972	6642	5865	4466
Degree-days, Sept. 1, to Apr. 30, Normal	1024	5192	3350	3613	6047	5988	4787

	Pittsburgh, Pa.	Portland, Me.	Portland, Oreg.	Providence, R. I.	Reading, Pa.	Reno, Nev.	Richmond, Va.
Degree-days for April, 1938.....	358	615	319	470	345	478	207
Degree-days, Sept. 1, '37 to Apr. 30, '38	4921	6518	3604	5508	4797	4959	3632
Degree-days, Sept. 1, '36 to Apr. 30, '37	4887	6270	4208	5343	4849	5742	3629
Degree-days, Sept. 1, to Apr. 30, Normal	5157	6644	4134	5764	5293	5436	3727

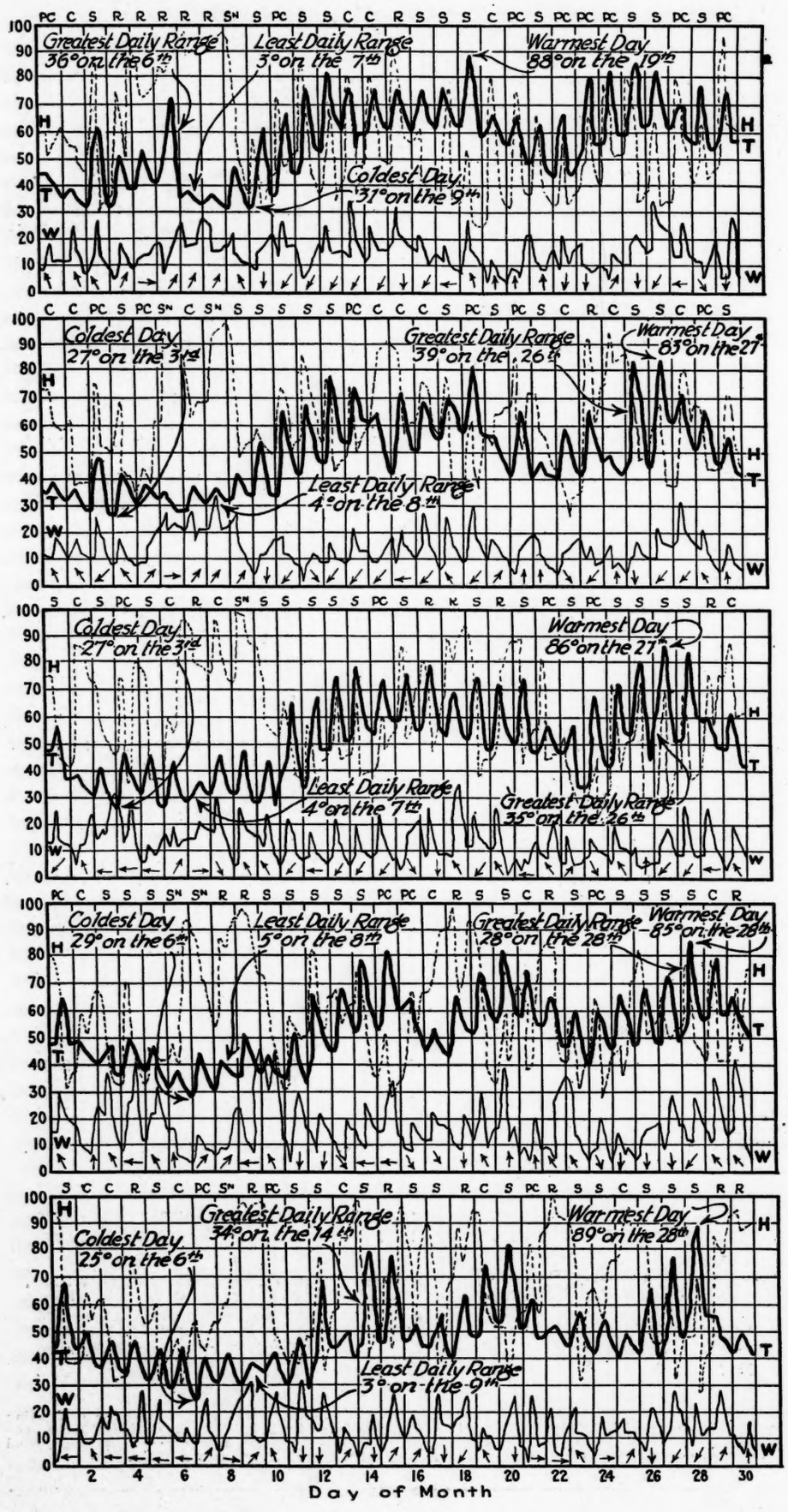
	Rochester, N. Y.	St. Louis, Mo.	Salt Lake City, Utah	San Francisco, Calif.	Scranton, Pa.	Seattle, Wash.	Spokane, Wash.
Degree-days for April, 1938.....	530	269	386	302	445	348	455
Degree-days, Sept. 1, '37 to Apr. 30, '38	6131	4289	4442	2185	5691	3695	5331
Degree-days, Sept. 1, '36 to Apr. 30, '37	6091	4704	5840	2558	5730	4330	6539
Degree-days, Sept. 1, to Apr. 30, Normal	6472	4585	5319	2417	5958	4396	5989

	Springfield, Ill.	Syracuse, N. Y.	Toledo, Ohio	Trenton, N. J.	Utica, N. Y.	Washington, D. C.	Wichita, Kan.
Degree-days for April, 1938.....	326	502	471	366	515	274	283
Degree-days, Sept. 1, '37 to Apr. 30, '38	4954	5994	5799	4887	6660	4139	4278
Degree-days, Sept. 1, '36 to Apr. 30, '37	5314	6026	5920	4859	6322	4136	4920
Degree-days, Sept. 1, to Apr. 30, Normal	5317	6614	5897	4852	6543	4601	4673

Methods of applying the degree-day in connection with the operation of heating plants or for the prediction of fuel consumption of heating plants are described fully in the new enlarged edition of the DEGREE-DAY HANDBOOK, published by HEATING & VENTILATING, 148 Lafayette Street, New York, price $3. Degree-days as given above for a "normal" month or season are based on averages for a long period of years, ending about 1922. Averages covering different periods will disagree with the above figures slightly.

THE WEATHER FOR APRIL, 1938

Plotted from records compiled for HEATING & VENTILATING by the U. S. Weather Bureau. Heavy curves (T), dry bulb temperatures in deg. F.; dotted lines (H), per cent relative humidity from readings at 8 a.m., noon, and 8 p.m. Light lines (W), wind velocity in m.p.h. Arrows indicate wind direction at maximum velocity, north being arrow pointing up, etc.; S—clear; PC—partly cloudy; C—cloudy; R—rain; Sn—snow.


Greatest Daily Range 36° on the 6th
Least Daily Range 3° on the 7th
Warmest Day 88° on the 19th
Coldest Day 31° on the 9th
Coldest Day 27° on the 3rd
Greatest Daily Range 39° on the 26th
Warmest Day 83° on the 27th
Least Daily Range 4° on the 8th
Coldest Day 27° on the 3rd
Warmest Day 86° on the 27th
Least Daily Range 4° on the 7th
Greatest Daily Range 35° on the 26th
Coldest Day 29° on the 6th
Least Daily Range 5° on the 8th
Greatest Daily Range 28° on the 28th
Warmest Day 85° on the 28th
Coldest Day 25° on the 6th
Greatest Daily Range 34° on the 14th
Warmest Day 89° on the 28th
Least Daily Range 3° on the 9th
H
T
W
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Day of Month

St. Louis

Mean temp. for month, 57.8F; aver. wind velocity, 13.5 m.p.h.; prevailing direction of wind, SW.

Chicago

Mean temp. for month, 50.2F; aver. wind velocity, 12.6 m.p.h.; prevailing direction of wind, SW.

Pittsburgh

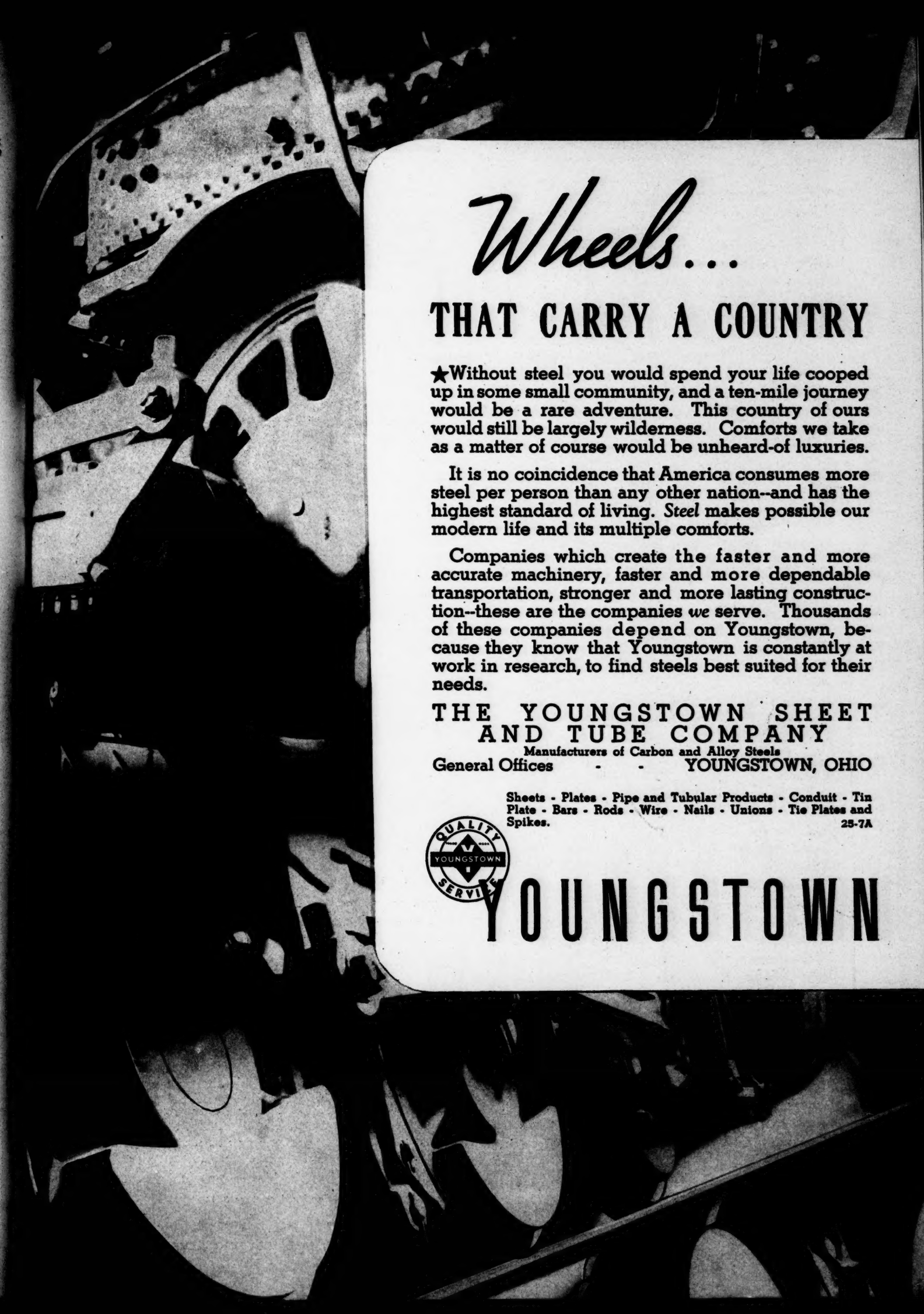
Mean temp. for month, 52.2F; aver. wind velocity, 11.9 m.p.h.; prevailing direction of wind, SW.

New York

Mean temp. for month, 53.4F; aver. wind velocity, 14.4 m.p.h.; prevailing direction of wind, SW.

Boston

Mean temp. for month, 48.7F; aver. wind velocity, 12.2 m.p.h.; prevailing direction of wind, SW.



Wheels...

THAT CARRY A COUNTRY

★Without steel you would spend your life cooped up in some small community, and a ten-mile journey would be a rare adventure. This country of ours would still be largely wilderness. Comforts we take as a matter of course would be unheard-of luxuries.

It is no coincidence that America consumes more steel per person than any other nation--and has the highest standard of living. *Steel* makes possible our modern life and its multiple comforts.

Companies which create the faster and more accurate machinery, faster and more dependable transportation, stronger and more lasting construction--these are the companies *we* serve. Thousands of these companies depend on Youngstown, because they know that Youngstown is constantly at work in research, to find steels best suited for their needs.

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon and Alloy Steels

General Offices - - YOUNGSTOWN, OHIO

Sheets - Plates - Pipe and Tubular Products - Conduit - Tin Plate - Bars - Rods - Wire - Nails - Unions - Tie Plates and Spikes.

25-7A

QUALITY YOUNGSTOWN SERVICE

YOUNGSTOWN

Heating a 5688-Room Housing Project

(Concluded from page 26)

ham the project manager and J. A. Velardi acting chief mechanical inspector.

Williamsburg Housing Project includes equipment as follows: sub-atmospheric steam system including system controls, radiator valves and traps, strainers, condenser and vacuum pumps, and unit heaters, by Dunham; boilers by Farrar & Trefts; fans by American Blower; unit heater motors by Emerson Electric; radiators by Arco; smoke breeching sheets by American Sheet & Tin Plate; unit heater controls by Minneapolis-Honeywell; pressure reducing valves and basket strainers by McAlear; globe and gate valves by Fairbanks; pipe covering by Johns-Manville; wrought iron pipe by Byers; hot water circulating pumps by Westco; steel pipe by National Tube; hot water regulating valves by Powers; water storage tanks by Patterson-Kelley.

Summer Degree-Hours for April

THE accompanying table gives the number of degree-hours above 85F for April, 1938 and 1937. Only one city, Savannah, had degree-hours in March.

SUMMER DEGREE-HOURS (85F BASE) FOR APRIL, 1938 AND APRIL, 1937

City	April, 1938	April, 1937
Baltimore	6	0
Birmingham	0	3
Bismarck	0	0
Boston	19	0
Buffalo	0	0
Chicago	0	0
Cincinnati	0	0
Cleveland	0	0
Columbus	0	0
Des Moines	0	0
Detroit	0	0
Fort Wayne	0	0
Grand Rapids	0	0
Houston	0	3
Indianapolis	0	0
Kansas City	1	0
Memphis	0	2
Milwaukee	0	0
Minneapolis	0	0
New Orleans	0	0
New York	0	0
Philadelphia	1	0
Pittsburgh	1	0
Portland, Ore.	0	0
Richmond, Va.	1	24
St. Louis	9	28
San Diego	0	0
San Francisco	0	0
Savannah	48	30
Toledo	0	0
Washington	12	36

WITH THE MANUFACTURERS

The American Rolling Mill Co., Middletown, Ohio, has elected *J. B. Tytus* vice-president in charge of operations. *Frank H. Fanning* has been named assistant vice-president in charge of operations.

Borg-Warner International Corp., Chicago, Ill., has named *Stuart F. Malcolm* manager of its electrical appliance refrigeration and air conditioning parts department.

The Bryant Heater Co., Cleveland, Ohio, has appointed *D. L. Mewhinney, Inc.*, 43 Prospect Ave., Mount Vernon, N. Y., as its direct factory distributor in Manhattan, Bronx, Staten Island and Westchester County, New York, and in Fairfield County, Conn. This distributor will be equipped to give advisory and engineering service in connection with Bryant equipment.

Conco-Sampsel Stoker Corp., Mendota, Ill., has appointed two new distributors for its line of stokers: *The National Sheet Metal Co.*, Atlanta, Ga., and *Heating and Cooling Corp.*, Montgomery, Ala.

Electrol Incorporated, Clifton, N. J., has named *Stanley H. Brown* vice-president and sales manager. *J. E. La Bahn* was appointed assistant vice-president.

Elgo Shutter and Manufacturing Co., Detroit, Mich., has appointed *Earl A. Soules* sales manager. Mr. Soules was formerly sales engineer of the Aire-Foile Fan & Blower Co., Detroit.

C. N. Lockwood

Fluid Heat Div., Anchor Post Fence Co., Baltimore, Md., has appointed *C. N. Lockwood* western manager with headquarters in Chicago. Mr. Lockwood was president of the Oil Burner Institute during 1937, and for the past eight years was sales manager of Nu-Way.

H. Lieblich & Co., New York, is celebrating its 30th anniversary in the oil heating field. The company has moved to larger and more modern quarters at *19 W. 44th St.*

The Marley Co., Kansas City, Kan., recently moved into its new building at *3001 Fairfax Road*. The main structure, 180 x 180 ft., houses the factory and warehouse on the first floor with national headquarters offices on the second. The building is equipped with a modern heating and ventilating plant, including 32 tons of air conditioning for the offices.

The compressor employed is two-cylinder, 32-ton unit, equipped with automatic reduction control, to cut it down to half its maximum capacity when required, operated by a two-point thermostat. A condenser of the two-pass horizontal shell and tube type is used.

Water cooling is provided by one of the company's small series cooling towers on the roof. One hundred g.p.m. are circulated through the tower with a spray water temperature of 95F and 85F as it enters the condenser. Three fin type cooling coils are placed in the air duct just ahead of the blower fans. In parallel ar-

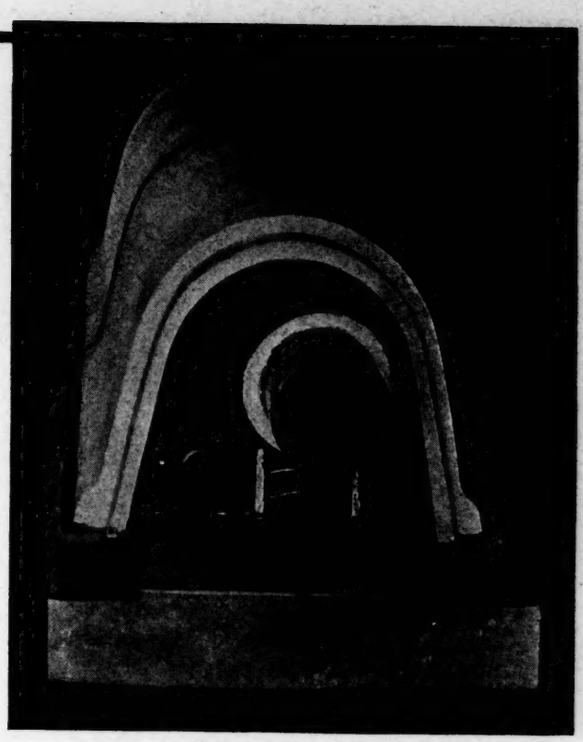
(Continued on page 80)

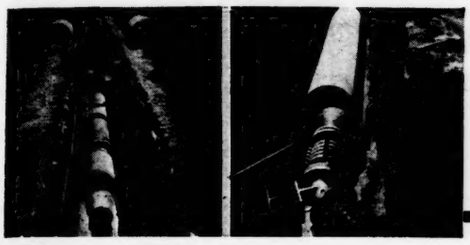
AIR-STONE CONDUIT

For Underground Steam Lines . . .

Simple construction! Efficient design! Easy installation! Air Stone Conduit provides high insulating value and maximum strength. Pipe lines are installed on rollers set in concrete base, then covered with precast conduit. Tight joints and best materials give a compression strength of 3000 lbs. in 28 days. Prove our claims by examining the Air Stone Conduit display at the Baltimore Convention.

See it at the Convention . . . .





S. E. DOCKSTADER

MUNSEY BUILDING, WASHINGTON, D. C.

Stop VIBRATION NOISE

in Compressor Lines

Rex Vibra-Sorbers absorb vibration, stop noise, insure permanently quiet operation. Sweated into the compressor lines, they act as flexible couplings for speedy, trouble-free installation. All sizes available.

VIBRA-SORBERS

Made by
CHICAGO METAL HOSE CORPORATION
Maywood, Illinois

ter Cooling
Air Washing
Humidifying

Side inlet, non clogging, low pressure water cooling nozzles with no internal parts . . .

Small two-piece nozzles for air washing and brine spraying . . .

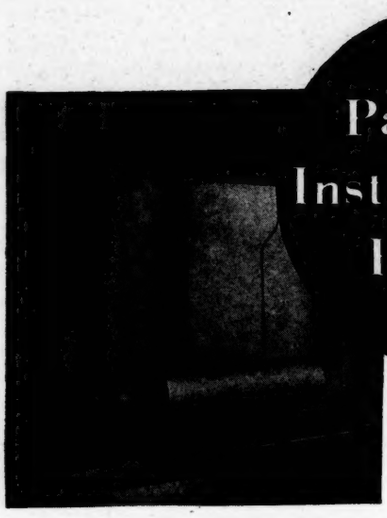
Simple, efficient humidifying nozzles. Easily taken apart.

Write for Bulletin No. 100.

THE MARLEY CO.
[illegible] Fairfax Road
[illegible] City, Kans.

MARLEY
SPRAY NOZZLES

Patterson Instantaneous Heaters



Patterson Instantaneous Heater for the air washer service in Civic Auditorium, Grand Rapids, Mich.

In considering the value of an instantaneous water heater, the responsibility of the manufacturer is a most important factor to keep in mind. The safest thing in the world to buy is reputation. The reputation and responsibility of the Patterson-Kelley Co. has never been questioned during the 58 years we have been in business.

Patterson Heaters are made with a heaping measure of quality and sold at the lowest possible price. *WRITE FOR CATALOG 201*

The Patterson-Kelley Co., Inc.

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Ray A. Smith
PRESIDENT

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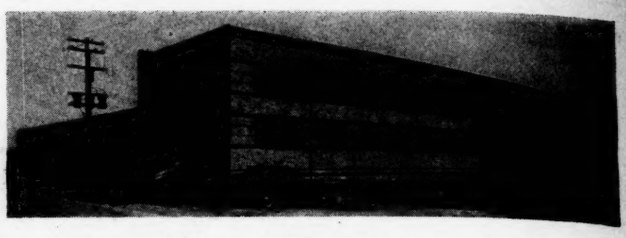

New Building of The Marley Co., Kansas City, Kan.

rangement are two natural gas furnaces which supply heat for the system during winter months. Heating for the factory floor and warehouse is supplied by gas unit heaters, several of which are double and triple units, at nine points.

The southeastern sales branch in the Walton Building, Atlanta, Ga., was opened during the last week in April, with *T. A. Tobin,* formerly of the home office sales staff, in charge.

Jas. P. Marsh Corp., Chicago, has moved its New York offices from 551 Fifth Ave. to larger quarters at *155 E. 44th St.*

Marsh-Tritrol Co., 720 N. Michigan Ave., Chicago, has appointed *C. H. Bevington* general sales manager. Mr. Bevington is also Chicago sales representative for Jas. P. Marsh Corp.

The Mercoid Corp., Chicago, has moved its New York office from 90 West St. to *330 West 34th St.*

Oil Devices, Columbus, Ohio, has named as chief engineer *Bruce Hayter,* formerly chief engineer of American Radiator's Institute of Thermal Research. In his work for Oil Devices Mr. Hayter will spend part of his time in this firm's research and experimental laboratory at Santa Fe, New Mex., and will also be available to manufacturer-users of Breese units as a consultant engineer.

Bruce Hayter

Penn Electric Switch Co., Goshen, Ind., has added *G. A. Wegner* to its factory staff of sales engineers.

Quaker Manufacturing Co., 223 W. Erie St., Chicago, has appointed *Sam Johnson* sales manager in charge of development and sales of its furnace division. Quaker is celebrating its 50th anniversary this year.

The Reliance Electric & Engineering Co., Cleveland, Ohio, has moved its New York office to *110 E. 42 St.,* and its Pittsburgh office to *355 Fifth Ave.*

Richmond Radiator Co., Inc., Uniontown, Pa., recently completed arrangements with Reynolds Corp., whereby the air conditioning and air conduit division of the latter company is now controlled by Richmond. Air conditioning units will be made at Richmond's plant in Uniontown and the South Kearny, N. J. plant will continue the production of conduit.

Sheffler-Gross Co., Philadelphia, Pa., has appointed *Specialty Products Co.,* Boston, Mass., exclusive distributor in the New England States for its Duoflo suction and discharge strainers.

Westinghouse Electric and Manufacturing Co., E. Pittsburgh, Pa., has placed Vice-President *Ralph Kelly* in charge of company sales. Vice-President *R. B. Mildon* assumes management of the E. Pittsburgh division; Vice-President *N. G. Symonds* will devote his time in

the sales department to customer activities, association work and special duties. *Roy A. McCarty* has been transferred to S. Philadelphia as manager of the steam and stoker division; and *B. H. Lytle* has been named manager at Lima.

Westinghouse Electric & Manufacturing Co., E. Pittsburgh, Pa., is centralizing the manufacture and sales of its Precipitron in its Cleveland, Ohio Division. *F. R. Kohnstamm*, manager of the Cleveland Division which also produces the company's lighting equipment, will supervise all activities in connection with this air cleaning development. *George F. Begoon* has been named sales manager.

L. J. Wing Mfg. Co., 154 W. 14 St., New York, has appointed *T. F. Schenke*, 704 Prospect Fourth Building, Cleveland, as its representative in that territory for its heating and ventilating equipment only.

NEW TRADE LITERATURE

Air Conditioning Accessories. A standard-size, condensed 24-page catalog, No. 88-G, describing the complete line of Imperial refrigeration and air conditioning valves, fittings, tools, dehydrators, strainers and allied items. More than 250 different items in a complete range of sizes are described. Also includes list prices. THE IMPERIAL BRASS MFG. CO., 1200 W. HARRISON ST., CHICAGO, ILL. 19

Air Cooling. Two folders describing the Kooler-aire conditioning units. These units are employed for supplying cool air to homes and commercial buildings at a low cost. One booklet describes the Midget Kooler-aire, which is a cooling system for small business establishments, while the other describes the Kooler-aire portable room unit. These units are designed to supply 100% outside air, to wash the air and to circulate it. They also can be used during the winter for supplying humidified air. Booklets describe the features, list specifications and give dimensional data. UNITED STATES AIR CONDITIONING CORP., MINNEAPOLIS..... 20

Air Filters. A standard-size, four-page bulletin, No. P-405-4, giving a detailed description of the Permo flameproof throw-away type filter. Gives information on construction, installation, capacities and resistance. INDEPENDENT AIR FILTER CO., INC., 228 N. LA SALLE ST., CHICAGO, ILL. 21

TO OBTAIN COPIES OF TRADE LITERATURE listed in this issue, without charge, circle on the list below the publications wanted, using the identifying item number at the end of each review; fill in your name and address, detach and mail to

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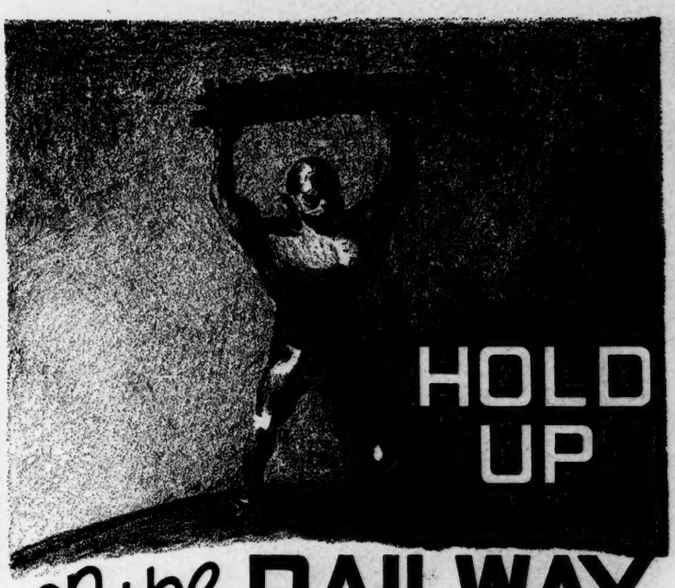

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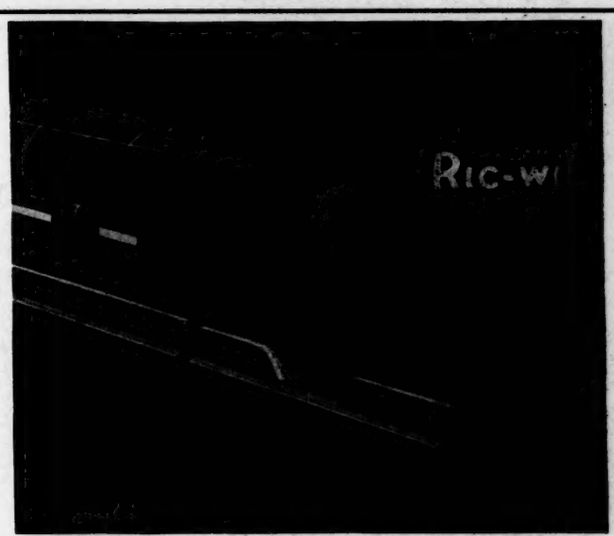

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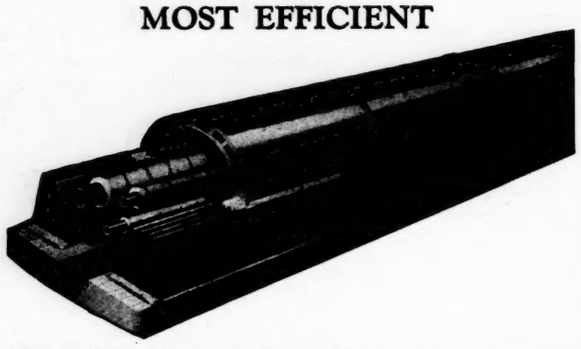

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Anemostats. A standard-size, loose-leaf catalog approximately 60 pages, giving complete information on the use and application of Anemostat high velocity air diffuser. This device is used for supplying air without drafts and for mixing room air with the conditioned air. Catalog contains a large number of illustrations showing typical applications, gives test data on the various types of Anemostats, lists of installations and capacity tables. Also includes sketches showing methods of fastening Anemostats, methods of controlling the volume, and a typical layout for a small theater. Capacity tables, dimensions and list prices are also included. ANEMOSTAT CORP., OF AMERICA, 10 E. 39 ST., NEW YORK. 22

Attic Fans. A one-page circular describing the new Chelsea Deluxe home cooling fans. These fans have capacities ranging from 9600 to 18,300 f.p.m. Information presented includes outstanding features, sizes, power consumption and net prices. CHELSEA FAN & BLOWER CO., INC., 370 W. 15TH ST., NEW YORK. 23

Attic Fans. Two-color circular, 38-1, describing the Johnson Health-aire attic ventilator. Includes information on features, specifications, sizes and capacities. Capacities range from 5000 to 13,000 c.f.m. JOHNSON FAN & BLOWER CORP., 1319-25 W. LAKE ST., CHICAGO, ILL. 24

Attic Ventilation. A two-page bulletin, No. 204-A, on the Coolvent system of ventilation. Gives information on installation, operation, performance and size. AUTOVENT FAN & BLOWER CO., 1805 N. KOSTNER AVE., CHICAGO, ILL. 25

Boilers. A standard-size, four-page folder entitled "Crane Stoker-Fired Boilers." Includes a full page of data and dimensions for stoker application together with explanatory diagrams. CRANE CO., 836 S. MICHIGAN AVE., CHICAGO, ILL. 26

Cooling Towers. Two loose-leaf, standard-size bulletins covering the Marley small series induced draft cooling towers. Bulletin No. 500 describes the Marley vertical towers for outdoor service. These towers are available in either wood- or spray-filled type. Bulletin No. 502 covers the horizontal towers which are designed for indoor service. These towers are wood-filled type. Bulletins give cross-sectional views, specifications, sizes, weights and dimensions. Bulletin 500 also has a map showing the midsummer wet bulb temperature data. THE MARLEY CO., KANSAS CITY, MO. 27

Controls. A standard-size, 32-page catalog D, describing the Dunco line of relays, temperature controllers and electric counters. Gives information on a large number of relays used for refrigeration, heating and humidity control equipment. Also describes mercury type thermostats. STRUTHERS DUNN, INC., 139 N. JUNIPER ST., PHILADELPHIA, PA. 28

Copper Tubes. A standard-size, 28-page booklet entitled "Anaconda Copper Tubes and Fittings for Heating Lines." This booklet is intended to be a manual on copper tube heating lines. It offers information on the following subjects: selecting tube sizes for forced circulation hot water heating systems; determining heat losses; radiator ratings; scale drawings; what amount of water to circulate; selecting a circulating pump; pipe sizing; plan layout of a copper tube reversed return system; frictional losses and carry capacity of tubes. THE AMERICAN BRASS CO., WATERBURY, CONN. 29

Drives. A standard-size, four-page, loose-leaf catalog describing the complete line of F.H.P. pulleys and flex-

ible couplings. Contains list prices, dimensions and engineering data. THE CONGRESS TOOL & DIE CO., INC., 9030 LUMPKIN AVE., DETROIT, MICH. 30

Electric Heaters. A standard-size, eight-page bulletin, No. 12, describing the Hynes line of fan circulation electric heating systems. Bulletin describes the essential features of the electric heaters, gives heater dimensions and illustrations of a number of typical applications. Also presents a table which shows the watts required per square foot per hour per degree temperature difference for various building constructions. Gives formulas to compute the wattage needed for infiltration and the total season's heating load. HYNES ELECTRIC HEATING CO., 240 CHERRY ST., PHILADELPHIA, PA. 31

Expansion Joints. A standard-size, eight-page bulletin, No. 200, illustrating and describing the various kinds of Badger packless expansion joints, the history of this type of joint, improvements brought out by Badger engineers, as well as uses, list prices, dimensions and weights of the Badger copper and stainless steel non-equalizing expansion joints. E. B. BADGER & SONS CO., BOSTON, MASS. 32

Electric Equipment. A standard-size, 18-page bulletin, GEA-2571B, on reconditioning flooded electric equipment. Gives general and detailed instructions for reconditioning such equipment as steam turbine generators, generators, motors, transformers, meters, switches, panels, relays, and like equipment. GENERAL ELECTRIC CO., SCHENECTADY, N. Y. 33

Valves. An eight-page, two-color booklet entitled "The Inside Story of Crane Plug Disc Globe and Angle Valves." Gives details of construction and outstanding features of the Crane plug disc globe and angle valves and also a table which lists the essential characteristics of each type of Crane plug disc line of valves. CRANE CO., 836 S. MICHIGAN AVE., CHICAGO, ILL. 34

COMING EVENTS

JUNE 13-15, 1938. Mid-Year Convention, National Warm Air Heating and Air Conditioning Association, Plankinton Hotel, Milwaukee, Wis.

JUNE 16-17, 1938. Annual Meeting, Stoker Manufacturers Association, Homestead Hotel, Hot Springs, Va. Chairman Convention Committee—J. E. Martin, Link-Belt Co., Chicago.

JUNE 19-21, 1938. 25th Summer Meeting, American Society of Refrigerating Engineers, The Pennsylvania State College, State College, Pa. Headquarters, Nittany Lion Inn.

JUNE 20-22, 1938. Semi-Annual Meeting, American Society of Heating and Ventilating Engineers, The Homestead, Hot Springs, Va.

JUNE 20-23, 1938. 31st Annual Convention, National Association of Building Owners and Managers, Hotel Schroeder, Milwaukee, Wis. Association headquarters, 134 S. LaSalle St., Chicago.

JUNE 28-JULY 1, 1938. 29th Annual Convention and Manufacturers' Exhibit, National District Heating Association, Lord Baltimore Hotel, Baltimore, Md. Wm. H. Sanford, Secretary-Treasurer, NDHA, 1317 Spruce St., Philadelphia, Pa.

SEPTEMBER 21-23, 1938. 16th Annual Conference, National Industrial Advertisers Association, Cleveland, Ohio. Stanley Knisely, Advertising Manager, Republic Steel Corp., Cleveland, Ohio.

DECEMBER 5-10, 1938. 13th National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York.

JANUARY 23-27, 1939—Annual Meeting, American Society of Heating and Ventilating Engineers, Pittsburgh, Pa.

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